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Modern Telegraphy. THE extent to which the dynamo is replacing the battery for telegraph work may be realized by an examination of our description, on another page, of a very characteristic plant. The eight dynamos and the two driving motors are so arranged as to occupy very little space, and the combination has shown itself to be thoroughly economical and reliable compared with the four thousand battery cells replaced. Specially where rather high potentials are required can the dynamo be used to advantage, for from their high internal resistance batteries are at their very worst when many are coupled in series. It will be but a few years before every main telegraph station within the reach of motor service will discard its batteries for the cheaper and more efficient dynamo.

The Institute of Electrical Engineers. THE meeting of the Institute of Electrical Engineers, Oct. 21, was perhaps more than usually instructive in its discussion of tests of a new type of alternating current apparatus. So much has been heard, and so little generally known, of the remarkable properties of the beautiful constant current alternator devised by Mr. William Stanley, Jr., and recently adopted by the Westinghouse Company that the description, with the details of its operation, was decidedly welcome. We reserve a detailed discussion of the facts shown until the publication of the paper in full, and content ourselves in saying that in the discussion which followed the report above mentioned there was much of interest to the electrical engineer, especially to students of alternating phenomena. It is hard to say too much of the work which has been done in the past year or two by the Institute of Electrical Engineers. The papers read before it have been already a valuable contribution to electrical literature, and no one who desires to keep thoroughly posted in electrical progress can afford to pass by unread the papers which appear at the meetings of the Institute. The present was the second meeting held in the new quarters, at the house of the Society of Mechanical Engineers, and all the members present were impressed with the admirable facilities for pleasant gatherings given by the attractive rooms in which the Institute is now fortunately settled.

The Electrician in Time of War. ALTHOUGH no strikingly new facts as to the employment of electricity in military and naval operations were brought out in Lieut. Fiske's lecture, printed elsewhere in our columns, the whole subject was discussed and will be something of a revelation to the reader. Few people outside of the scientific branches of government service have any thorough realization of the immense extent to which electricity can be utilized in modern war. Lieut. Fiske puts all this in the plainest manner; and is so thoroughly satisfied of the importance of the subject that he earnestly recommends the formation of an electrical corps, bearing to the engineering staff, or the engineering corps of the regular army, about the same relation that the National Guard does to the line. The formation of such an organization would place at the service of the government, in case of need, a great body of electrical experts, who would leave nothing undone to give the army and navy as complete an electrical outfit as the science of the present or the exigencies of the future could demand. The suggestion is rather an attractive one on the whole, and there is certainly no reason why a special engineering corps of this sort is not a legitimate part of the military organization. As a rule, the average American citizen pays altogether too little attention to the importance of national self-defense; and, aside from the direct advantage of an electrical corps, it would tend to awaken in an educated and influential body of men a new sense of the importance of readiness for national defense.

Politics and Electricity. IT is really a pity that electricity cannot purify that variety of sewage known as practical politics. On plain, ordinary filth it has been shown to accomplish remarkable effects, but it must be admitted that in the extreme case just mentioned it is well nigh powerless. Were it otherwise there would be, around the nether pole of society, a dense deposit of ex-officials a few days hence. The present incumbrance of the mayor's office has throughout his term exhibited the greatest activity in searching out the most elaborate and ingenious plans for hindering the electrical development of the metropolis; and having found them he has gleefully hastened to execute them. At first his violent attacks on the overhead wires won from the public a certain amount of commendation, under the delusion that they were instigated by a sincere desire to enforce the laws. Had this enthusiasm extended to certain other subjects, there might have been ground for this fond belief; but Mayor Grant's rancorous opposition to everything that might facilitate the construction of cheap and good subways, his venomous assaults on the expert of the Board of Electrical Control, and his persistence in fostering every sort of electrical bugaboo that can be conjured up to affright the public, coupled with his general apathy in guarding the general welfare, have shown its falsity. It would be hard to imagine a more puerile attempt at bluff than his threat to deprive the city of decent illumination rather than pay the necessary increase of price brought about by the somewhat peculiar transactions that have produced the official superheated subways. Altogether, so far as the immense electrical interests of this great city are concerned, he has made his office obnoxious and himself cordially detested. No electricians will weep over the political grave to which they trust he will soon be consigned.

Thermo-Electric Battery Tests. ELSEWHERE in our columns may be found some rather instructive tests of a thermo electric battery. Inasmuch as batteries on this principle have been frequently suggested as methods for getting electricity direct from heat, it is worth while to look in detail at what has been and is likely to be accomplished. The Gulcher thermo-battery, with which the present experiments were tried, is a representative of the most approved modern type of thermo-battery. It is constructed of efficient materials, and its mechanical arrangement to secure utilization of the heat is rather better than usual. Nevertheless, the resulting efficiency is extraordinarily low—above 30 litres of gas per watt hour was the best performance of the apparatus tested. Inasmuch as this amounts to about 800 cubic feet of gas per electrical h. p. hour, it will be very readily seen that this method of obtaining our electrical energy from heat is uneconomical to the last degree. It has already been pointed out from a theoretical standpoint that thermo-electricity can only be obtained at an unreasonably great expenditure of energy. Nevertheless, it is instructive to observe that the practical performance of the apparatus is, if anything, less promising than theory would indicate. Inasmuch as the thermo-electric properties of all except the rarest elements and alloys have been at one time or another investigated and the couple utilized in the Gulcher battery is one of the best combinations that could be made, it certainly seems as though experiments of this sort should put the thermo-battery, as a practical electric generator, so far in the background that enthusiastic inventors will not be likely to revive it. Thermopiles, however, like primary batteries, have a very useful field of their own in cases where expense may be advantageously subordinated to convenience. Where a very steady current is required the thermo-battery stands unequaled. Its output can be made, probably, more nearly uniform than that of any other known form of battery, and for testing purposes where this is an advantage, quantitative analyses by electrolysis, and similar work, the thermo-battery has very many advantages. We hope, nevertheless, that Mr. Uppenborn's valuable research, added to what has already been done on the same topic, will cause the public to look very carefully into any proposition to obtain electricity on a commercial scale from any process of utilizing the thermo-electric properties of metals.

Rheostat vs. Commutations. THE regulation of electric railway motors is a problem that has shown itself to be full of pitfalls for the unwary. It is no easy matter to graduate the speed of an electric motor for such service without considerable complication or objectionable losses of energy due to resistance. The great difficulty is in the fact that when an electric car is started the driving motors are called upon for an output considerably above the normal, and the motor being started from rest there is a rush of current which both tends to bring the car into motion with a sudden jerk, instead of gradually, and also to throw a dangerous excess of current through the field coil of the armature. Aside from this, even if the car has gathered headway, the graduation of its speed in accordance with the demands of traffic is not a particularly simple matter to adjust. A short paper by Dr. Hutchinson in our present issue gives some account of the methods used in the Sprague and Thomson-Houston systems, which at present operate by far the greater portion of electric railways. Although there is nothing specially secret about the details of either system, they are not extensively known to the electrical public. Dr. Hutchinson specially describes one of the recent devices of a well known inventor for a system of regulation involving the combinations of two motors instead of making simpler changes in each. It transpires that the practice of both companies has tended in the same direction, and that, too, a compromise between regulation by varying the number of effective turns on the field magnets and lowering the potential at the terminals by interposing a resistance. The former method, although it is very well adapted to change the speed of the motors after they are under way, does not obviate the tremendous rush of current at the start unless the field coils are made of a resistance higher than practice has shown to be desirable. Both systems, therefore, now interpose a resistance to choke this initial current; but while this is removed as a whole in the Sprague system as soon as the armature gets fairly into motion, it is cut out gradually in the Thomson-Houston arrangement. After the start all the speed and power regulation of the Sprague system is accomplished by changing the number of effective turns on the magnets. The Thomson-Houston regulation makes a single change in the number of effective turns and accomplishes whatever other adjustment may be necessary with the rheostat. A compromise between these two systems is exhibited in the new Westinghouse motors, where an arrangement of field coils similar to the Thomson-Houston is employed together with a resistance for starting purposes which is neither a rheostat, properly speaking, nor a single coil, but a coil in three sections which can be used as required. It will thus be seen that in facing the same problem the three systems have adopted very similar means of employing a resistance at start and of changing the winding of the field magnets. The Sprague resistance coil is cut out almost immediately; in the others more gradually, although completely. The more complicated arrangement described by Dr. Hutchinson is peculiar in its use of the two motors and has not yet found its way into the actual practice of the company that has devised it. This question of regulation will continue to be a difficult one unless a flexible connection between motor and gearing can be devised which will regulate speed economically. A flexible connection to avoid the use of a resistance at starting is quite practicable, and several such have been brought out at the present time; but whether a method of speed regulation based on the same principles can be made any more efficient than the present regulating devices can be established only after thorough experimentation. Mechanical losses are no less objectionable than electrical ones unless they can be made smaller.

NEW BOOKS.

Incandescent Electric Lighting. By L. H. Latimer, C. J. Field and John W. Howell. Pp. 140; 40 illustrations. New York: D. Van Nostrand & Co. 50 cents.

This little book contains, in a small compass, a very useful and intelligible account of incandescent lighting according to the methods used by the Edison Company. It consists of three distinct papers: the first being a practical description of the Edison system, which gives a very clear and intelligible account of the apparatus and methods employed in incandescent lighting; a discussion of the design and operation of incandescent stations, by Mr. C. J. Field, giving especially the details of the very excellent station in Brooklyn, designed by the author and described by him in full, substantially as heard at the Kansas City meeting of the National Electric Light Association; and, finally, the well-known paper on the maximum efficiency of incandescent lamps, read some time since before the Institute of Electrical Engineers. These three papers are well chosen to accompany each other in giving a clear idea of incandescent lighting, and it is convenient to have them brought together in a very handy form for reference, familiar to every one, in the Van Nostrand science series.

Testimony Taken Before the Senate Committee on General Laws as to Electricity and Electric Lighting. Transmitted to the Legislature May 1, 1890. Albany: James B. Lyon, State Printer. 1890.

The investigations recorded in this volume of evidence were undertaken by the Committee on General Laws; in pursuance of the resolution of the State Senate directing them to prosecute an investigation of the methods now employed in furnishing electricity for lighting and power purposes as now communicated in the various cities, towns and villages in this State. Their purpose was to look into possible dangers to life and property and to recommend measures for lessening them. A State investigation of this kind necessarily involves a certain amount of buncombe. It also becomes the scene of commercial ax-grinding to an extent which seriously lessens any scientific value that it might otherwise have. Nevertheless, the present volume contains very much that is interesting, and some of the testimony was exceedingly level-headed. Dr. Wheeler, Dr. Henry Morton, Mr. William Maver, Jr., Mr. E. H. Johnson, and others well known to electricians were examined, and their evidence was specially clear and full. Still the summation of it all was far from putting the minds of the legislators at rest, because many of the statements were of a conflicting character, as the relative effects of high and low tension currents are legitimately a subject of individual belief. In the final results of the investigation the effect of the high tension scare was very noticeable, although the recommendations of the committee were on the whole more judicious and conservative than was to have been expected under the circumstances. The final conclusion of the committee, after the investigation, was in favor of underground conductors in all cities of over 125,000 inhabitants. Why this limit was drawn it was hard to see. If it is not possible to insulate a wire so as to render it safe, then, surely, the inhabitants of cities whose population is less than that magical limit ought not to be exposed to the possible dangers of the "deadly current." If on the other hand, a wire can be properly insulated, there is no excuse for making so sweeping a demand for putting the wires underground. It is one of those cases where common sense as well as general regulations can be utilized to great advantage. On the whole, the volume is well worth reading, both for the positive information it contains, and also from the somewhat humorous collection of *ex parte* evidence that lurks here and there between its sober looking covers.

Traite d'Electricite et de Magnetisme. By A. Vaschy. Vols. I. and II. Baudry. Paris, 1890. Vol. I., pages 430, 75 illustrations; Vol. II., pages 520, 305 illustrations.

Considering the very large amount of admirable electrical work that has been done in England in the past few years, it is a singular thing that general treatises on electricity and magnetism by English authors have been very few in number. We have, to be sure, the powerful mathematical treatise of Maxwell and the little less abstruse volumes of Watson and Burbury; of a very much less technical character, the entertaining though somewhat ill-balanced volumes by Gordon. Aside from these, very little. There are a number of admirable elementary books and monographs, but it seems to have been left for the French to evolve a succession of treatises covering the field of electricity and magnetism in a very clear and practical way, without the immensely complex mathematics of Maxwell, but still with a sufficient amount of electrical theory to make them well fitted for text books of higher electrical engineering. The best known of these works is the admirable treatise of Mascart and Joubert. Following something in the same line, but perhaps rather less theoretical, are the present volumes by Vaschy. Of these, the first is devoted to the more theoretical discussion of the subject, the latter volume to apparatus and measurements. It will be seen that the arrangement is not dissimilar to that found in Mascart and Joubert, but the details are somewhat different. In the very first chapter we find a discussion of fundamental laws of electricity that will bear very careful reading; and later, the canonical equations of electrostatics are given in their ordinary form; then in succession come the chapters on condensers and on the phenomena of dielectrics in general. The second part of the book discusses electrokinetics; electric conduction in two or in three dimensions; electrolysis, and electric batteries. The third section, following the same general line of development, treats of magnetism; and the fourth of the electromagnet and the theory of electrodynamics in general. This, as will be seen, covers the ordinary range of subjects found in every electrical treatise, and does not differ widely from the methods with which we are already familiar.

In the second volume, which deals with practical applications of electricity, there is more of novelty, although of necessity a familiar arrangement is often exhibited. There is a rather good chapter on periodic currents, although there is nothing in any foreign tongue to compare with the admirable monograph of Fleming. Electrical measuring instruments and meters are treated at considerable length, and as a rule the descriptions are very well given; the ballistic galvanometer, its properties and uses, is given a larger place than is usual in books on practical electricity, and this is an admirable feature in M. Vaschy's volume, for the ballistic galvanometer is very indifferently described in most text books, and the student is left altogether too much in the dark with respect to the precautions to be taken in its use. In the further chapters on electrical measurements there is nothing of especial interest and novelty until we reach the chapters on the special methods of measurements employed in aerial and submarine telegraph lines. This subject is M. Vaschy's particular field, and, as a consequence, the methods of testing and investigation employed in the telegraph and cable service receive far more attention than is usually found in text books. Taken altogether, the volumes before us are well worth a place on the reference table of the engineer or electrical student. Although the lines followed in the development of the subject are not strikingly novel, the work is carefully written, and the great body of facts which must, of necessity, form a part of the intellectual stock in trade of every electrician, are rendered thoroughly available. It is to be hoped that ere long we may have, in English, some thoroughly good semi-theoretical text-book, covering this very important field. As it is now, the students who do not read French practically have to rely on the translation of Mascart and Joubert, unless they desire to sound the profounder depths of mathematical electricity.

Some Features of the Sprague and Thomson-Houston Systems of Electric Tramways.

BY DR. CARY T. HUTCHINSON.

The question is often asked, "What is the difference between the Sprague and Thomson-Houston systems?" and the answer usually is that the chief difference lies in the method of regulating the speed of the car; the Sprague motors are regulated by "commutating" the field coils, the Thomson-Houston by introducing a variable resistance into the circuit of the motor.

Probably the latest discussion of this point took place at the eighth annual meeting of the Street Railway Association of the State of New York a few weeks ago. The printed report of the remarks of a representative of the Thomson-Houston Company at this meeting contains the following statements: "The Thomson-Houston Company has long recognized the fact that the electrical railway apparatus is not so much an electric as a mechanical problem. We have aimed to get it as simple as possible. We use no commutated fields. We made up our minds that it is a good deal better to spend a little more money for coal and avoid wear and tear.* Our motors are plain series wound. We use the much-abused rheostat. Our latest construction is perfectly simple."

I wish it understood at once that I do not intend the following remarks to be taken as a comparison of the merits of the two systems; they are only intended to point out the differences.

Governing by "commutated fields" consists in changing the number of turns of wire on the fields of the motor; this, of course, for any given current, changes the number of ampère turns, the counter electromotive force and the speed. In this method the change of resistance introduced by the change in the arrangement of the sections of the field winding is a necessary evil and not a means relied upon for governing. Governing by "rheostat" consists in changing the potential difference at the armature terminals, for a given current, by causing part of the fall of potential to take place over a resistance; the potential difference at the terminals being different, the speed will be different. In this case inserting additional resistance slows the speed of the car, decreases the load and demands less current, creating therefore a weaker magnetic field and a tendency to increase of speed; that is to say, in this method of governing the actual speed is the resultant of two opposing tendencies, mutually dependent; in the first case an increase of the ampère turns is accompanied by an increase in the field resistance, creating therefore an additional tendency to diminish the speed; the actual speed will then be the resultant of the two concurrent tendencies mutually dependent.

On the Thomson-Houston motors the field winding, it is true, is not sectional as far as its mechanical arrangement goes, but it is sectional in the electrical arrangement; the winding is double, having two different numbers of turns according as the "loop" or the "end" is connected. The number of turns differs by about a third. This motor then has a commutated field with two changes, and of course both motors are "plain series wound"; there are shunt coils on either.

The rest of the statements quoted can best be illustrated by describing briefly the latest construction of that company; we can see then how simple it is not, and how prominent are the electrical features.

I have before me a sketch of the recent plans of the Thomson-Houston Company's engineers; *i. e.*, of their type "B" street car controller. It is evident that they think the "much abused rheostat" has been justly abused, for this plan omits it altogether. In its place is a resistance box, which is cut out as a whole; *i. e.*, at one movement. In brief, the plan is to start the car with the two motors in series with each other and with a resistance; on the second position the resistance is cut out, leaving the two motors in series with the current through the "end" of the fields; on the third, the motors are still in series, but the current goes through the "loop" of the fields; on the fourth, the armature alone of one motor is in series with the other motor on the "end"; on the fifth, this solitary armature is cut out and there is left one motor on the "end;" on the sixth, both motors are thrown in parallel on the "end," and finally on the seventh, the two are in parallel on the "loop."

This can be shown clearly by diagrams: Call A the armature; G, the end of the field winding common to both "loop" and "end;" L, the "loop" end; E, the "end" end; R, the resistance box. G-L will then mean that the current flows only through part of the field winding; and G-E that it flows through the entire winding. The different arrangements are shown by the table below, subscripts 1 and 2 referring to the two motors:

Table I.

Position.	Circuit.
1	Trolley–A_1–G_1–E_1–R–E_2–G_2–A_2–Ground.
2	Trolley–A_1–G_1–E_1–E_2–G_2–A_2–Ground.
3	Trolley–A_1–G_1–L_1–L_2–G_2–A_2–Ground.
4	Trolley–A_1–E_2–G_2–A_2–Ground.
5	Trolley–E_2–G_2–A_2–Ground.
6	Trolley < E_1–G_1–A_1 / E_2–G_2–A_2 > Ground.
7	Trolley < L_1–G_1–A_1 / L_2–G_2–A_2 > Ground.

Notice that for No. 4 one armature is in the circuit with the other motor. There would seem to be a very considerable deviation from perfect simplicity in this, but the case is even worse when the arrangements for accidents are considered; there must, of course, be a cut-out for each motor for the purpose of throwing it out of the circuit whenever an accident happens to it.

Suppose the cut-out switch on this controller is thrown so as to cut out motor No. 1; then the circuit will be as shown in the table below for the various switch positions:

Table II.

Position.	Circuit.
1	Trolley–R–E_2–G_2–A_2–Ground.
2	Trolley–E_2–G_2–A_2–Ground.
3	Trolley–E_1–L_1–L_2–G_2–A_2–Ground.
4	Trolley–E_1–G_1–E_2–G_2–A_2–Ground.
5	Trolley–E_2–G_2–A_2–Ground.
6	Trolley–Ground (line short circuited).
7	Trolley–Ground (line short circuited).

But if the cut-out switch is thrown so as to cut out motor No. 2, the circuit will be as follows:

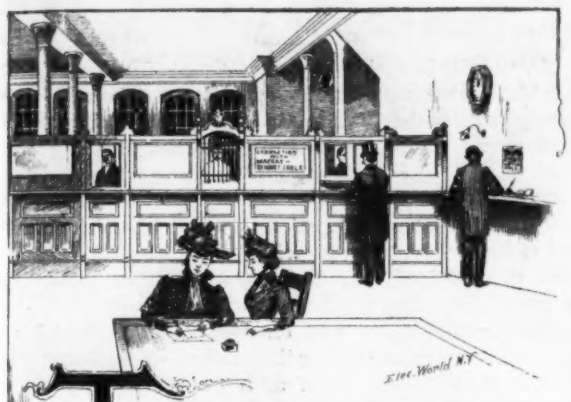
Table III.

Position.	Circuit.
1	Trolley–R_1–A_1–G^1–E_1–Ground.
2	Trolley–A_1–G_1–E –Ground.
3	Trolley–A_1–G –L_1–Ground.
4	Trolley–A_1–Ground.
5	Trolley–Ground (line short circuited).
6	Trolley–Ground (line short circuited).
7	Trolley–Ground (line short circuited).

An examination of these tables shows that the first three positions give all the different arrangements possible with one motor; they are: Resistance and motor on "end," motor on "end," motor on "loop;" when motor No. 1 is cut out part of field winding is still left in the circuit on positions 3 and 4, but this resistance is small and will not affect materially the action of the remaining motor; positions 4 and 5, Table II., are then merely repetitions of No. 2, while No. 6 and No. 7 short circuit the line. In Table III. it is seen that all beyond 3 short circuit the line; some device must therefore be used to prevent the controller from being moved beyond No. 3 when either motor is cut out; I do not know what plan is resorted to, but whatever it is it certainly detracts from the "perfect simplicity" which is said to be the cardinal feature of the Thomson-Houston apparatus.

This apparatus is, as far as I know, not yet in use anywhere except on the Lynn road, where it was under test some time ago. Of course, not being within the councils of the Thomson-Houston Company, I cannot say what changes have been made in the details of this plan since June last; but the fact of its approval then shows that something better than a rheostat is being sought, even at a considerable sacrifice of simplicity.

* I am glad to see the acknowledgment of this fact.—C. T. H.



Dynamo Plant of the Postal Telegraph-Cable Company, Boston, Mass.

THE leading telegraph offices of the country are one by one adopting the dynamo as the source of the currents used on both local and long-distance telegraph circuits. In every instance where such a plant has been installed it has replaced thousands of cells of battery, reduced the labor and expense necessary in the care of the plant, decreased the cost of operation, added to the efficiency and reliability and in actual service has given the greatest satisfaction to the operating company. When it is considered that the displacement of 5,000 cells of battery means also that 10,000 wire connections with all their attendant annoyances and "troubles" are removed from the circuits which must be kept in working order, it is a matter of some surprise that more of the large telegraph offices of the country do not derive their currents from the dynamo in preference to a very large number of cells of gravity or other battery. Now that several large plants of this kind are in successful operation in New York, Chicago, Pittsburgh, Boston and other cities, there can be no question regarding their adaptability to this class of work. The consumption of coal in producing the dynamo currents, when compared with that of zinc in the batteries, leaves little to be said in favor of the latter, while the smaller amount of space occupied by the dynamo plant, together with its greater reliability and more satisfactory regulation of the current produced, is very decidedly in favor of the mechanical method of producing the necessary current.

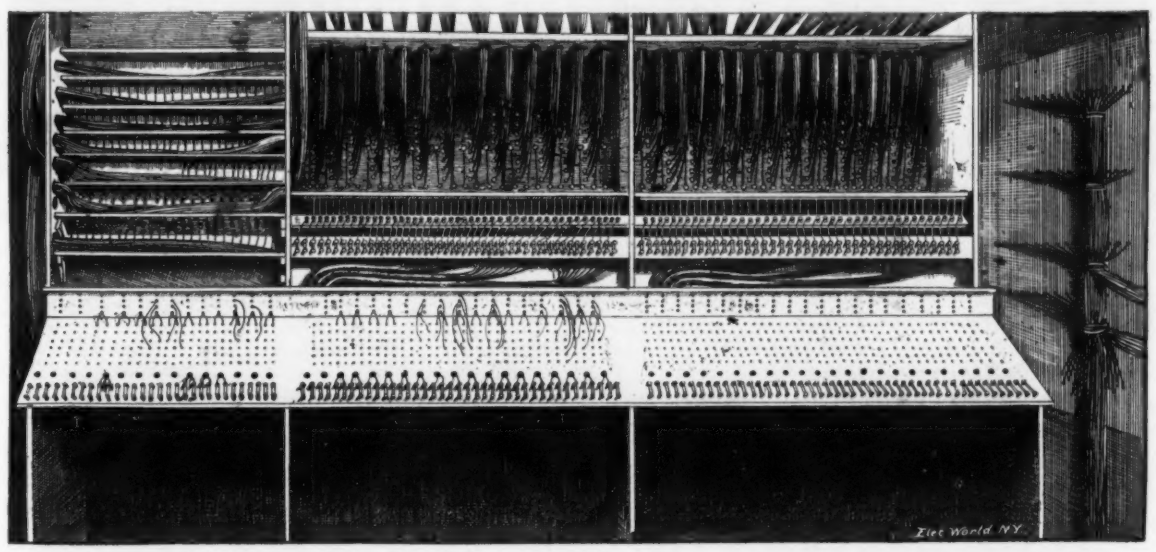
Several of the most important plants of this character have been described in the columns of THE ELECTRICAL WORLD from time to time as they were installed and put into operation. The first dynamo plant which was put into service in the Western Union office in this city, in 1880, a system which was the invention of Mr. Stephen D. Field, was very fully described in THE ELECTRICAL WORLD of April 14, 1883, while a complete description of the remodeled plant was contributed to THE ELECTRICAL WORLD by Mr. William Maver, Jr., and may be found in the issues of February 11 and 18, 1888. A description of the plant in the Western Union office at Pittsburgh appeared in THE ELECTRICAL WORLD of Oct. 13, 1888, and of the Chicago installation of the same company in the issue of March 1, 1890. The Albany dynamo plant of the Western Union was described in the issue of April 12, 1890, and a complete account of the installation in the New York office of the Postal Telegraph Company appeared in THE ELECTRICAL WORLD Aug. 11, 1888.

We are able to present to our readers this week, through the courtesy of Mr. E. B. Pillsbury, the manager of the company, some illustrations and a full description of another important installation of dynamos as a source of telegraphic currents. This plant was recently put in operation at the office of the Postal Telegraph-Cable Company, at 234 Devonshire street, Boston, Mass., and is giving excellent satisfaction.

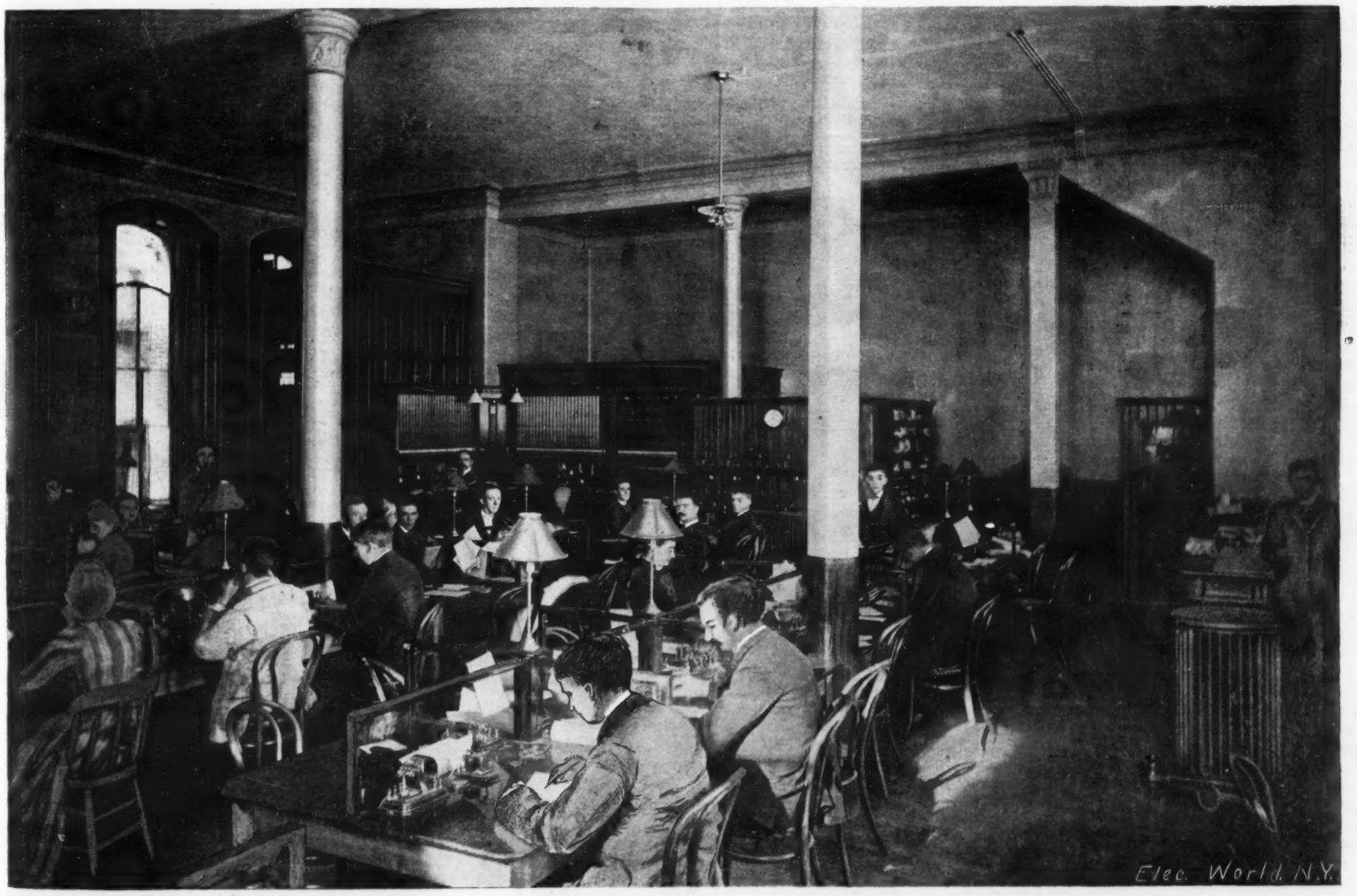
This plant consists of eight dynamos and two motors of the Westinghouse direct current type. The total capacity of the eight dynamos is 26 ampères, and these are so arranged as to provide for four different voltages, viz.: 40, 90, 130 and 375 volts. The dynamos are connected in pairs, each pair consisting of a positive and a negative machine of the same voltage. Seven machines are in constant use, while one is kept in reserve. The current from these dynamos is used to operate all of the company's local, city, main, duplex and quadruplex circuits, including repeaters. It is a noteworthy fact that there is not a single cell of battery remaining in the establishment, as all the circuits derive their current from the dynamos. The number of cells replaced by this plant was 4,000, and the dynamos are now satisfactorily doing the work of generating currents formerly done by this large number of batteries.

Power to drive the dynamos is furnished by two Westinghouse direct current motors of the same general type as the dynamos and having a capacity of 10 h. p. each. The motors are supplied with current from the underground system of the Edison Illuminating Company, connection being made with two of that company's Boston central stations so that any serious accident at either one of these would not result in a failure of the supply of current. The motors are run alternately, only one being used at a time, as one motor is sufficient to furnish the necessary power. The second one is always in reserve ready for use in case of accident. The dynamos and motors are connected, as is shown in the accompanying illustration of the dynamo room, through countershafting, and only the best quality of cotton-leather belting is used.

The current on the various circuits is regulated by 500



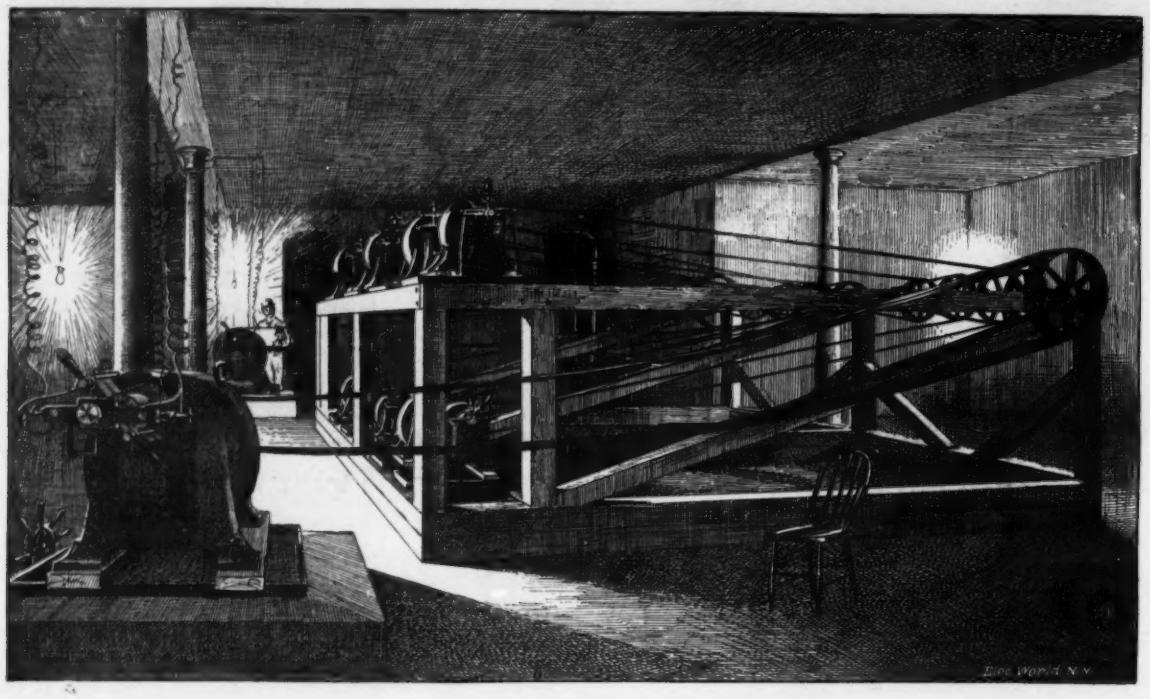
REAR VIEW OF SWITCHBOARD, POSTAL TELEGRAPH-CABLE COMPANY'S BOSTON PLANT.



OPERATING ROOM OF THE POSTAL TELEGRAPH-CABLE COMPANY AT BOSTON MASS.

resistance coils, located at the back of the switchboard, and especially designed by Mr. F. W. Jones, the electrician of the company, under whose supervision the entire plant was installed. The switchboard, a back view of which is shown in one of the accompanying illustrations, has a capacity of 100 wires and the loop switch will accommodate 18 quadruplex sets and any number of loops. By an ingenious arrangement any two quadruplex sets can be coupled so as to repeat into each other, or any single circuit can be readily made to work into any quadruplex.

As will be seen from the interior view of the operating room, the office is heated by steam and lighted by incandescent lamps, the fixtures for the operating tables being of special design. In the work of wiring the office eight miles of inside wire were used. The operating department contains table room for 90 operators, the present staff numbering 50. The company is well established in Boston, having 20 branch offices in the most important business centres of the city, all in a flourishing condition. The system of the Postal Company now reaches all but six States and Territories of the country and covers the larger part of Canada. About 1,500 offices and 90,000 miles of telegraph line are now in daily operation for the transaction of the company's business.



DYNAMO ROOM OF THE POSTAL TELEGRAPH-CABLE COMPANY'S PLANT, BOSTON, MASS.

Report of the Commissioner of Patents.

The report of Commissioner Mitchell, of the United States Patent Office, for the fiscal year ending June 30, 1890, shows the following statistics of the transactions of the patent office with comparisons as given below:

Applications for letters patent	40,201
Applications for re-issue patents	121
Letters patent granted, including re-issues and designs	25,857
Letters patent withheld for non-payment of final fee	3,403
Letters patent expired	11,885
RECEIPTS AND EXPENDITURES.	
Receipts from all sources	$1,247,203.21
Expenditures (including printing and binding, stationery and contingent expenses)	1,081,173.56
Surplus	$266,029.65

In 1886 the number of applications for patents, including reissues, designs, trademarks and labels, was 38,678; in 1887, 38,408; in 1888, 37,769; in 1889, 39,702; as compared with 43,810 in 1890. On July 1, 1886, the number of applications awaiting action on the part of the office was 6,772; July 1, 1887, 7,601; July 1, 1888, 7,227; July 1, 1889, 7,073; as compared with 6,585 on July 1, 1890.

Regarding the need of additional examiners the report says: "Because of the large increase in the number of applications for patents, and because of the necessity of more deliberate and exhaustive examination, and because of the fact that American inventors are already paying the necessary expenses, I recommend a substantial increase in the examining corps of the Patent Office. Of course such an increase would necessitate a corresponding increase in the clerical and laboring force of the bureau. There are now thirty examining divisions. They should be increased to thirty-two, at least, and the additional force of examiners should include two principal examiners and at least 15 assistant examiners of various grades."

Concerning the need of a change in the jurisdiction of the Examiners-in-Chief Commissioner Mitchell says: "The Board of Examiners-in-Chief, consisting of three members, was created by act of Congress, approved March 2, 1861. One purpose assigned by the statute creating the Board was "for the purpose of securing greater uniformity of action in the grant and refusal of letters patent." The Examiners-in-Chief have jurisdiction over appeals from the decisions of the Primary Examiners and the Examiner of Interferences. From all decisions of the Examiners-in-Chief further appeal lies to the Commissioner. I am satisfied that this latter appeal should be done away with. The term of office of the Examiners-in-Chief is permanent, and the highest appellate tribunal of the office should, like other judicial bodies, possess a permanent tenure. Another reason is found in the fact that with the growth of the business in the Patent Office it has become impossible for the Commissioner to discharge properly his appellate judicial powers as now devolved upon him by law. I am satisfied that no appeals should come to the Commissioner from the Examiners-in-Chief, and that his judicial jurisdiction over that body should go no further than to grant new trials and rehearings in proper cases, according to the principles regulating such proceedings. I therefore recommend that proper steps be taken to secure an amendment to the law, having the effect to cut off all appeals from the board of Examiners-in-Chief to the Commissioner, and at the same time affording the Commissioner the power to grant new trials or rehearing. The appeal which now lies in *ex parte* cases from the Commissioner to the Supreme Court of the District of Columbia should be made to lie direct from the board of Examiners-in-Chief to that court."

Some important recommendations are made concerning the limitations of patents, and upon this subject the Commissioner says: All persons competent to judge in the matter agree in the conclusion that section 4,887 of the Revised Statutes should be modified so as to prevent a foreign patent previously obtained from affecting the duration of the American grant to the same inventor for the same invention. It should be added that by no method can the Patent Office always satisfy itself whether a foreign patent has been obtained or not. An application, for instance, may be pending in the British Patent Office six months and may become a patent two days in advance of the date of the American grant to the same inventor for the same invention."

Electric Light Plant at Jenkintown, Pa.

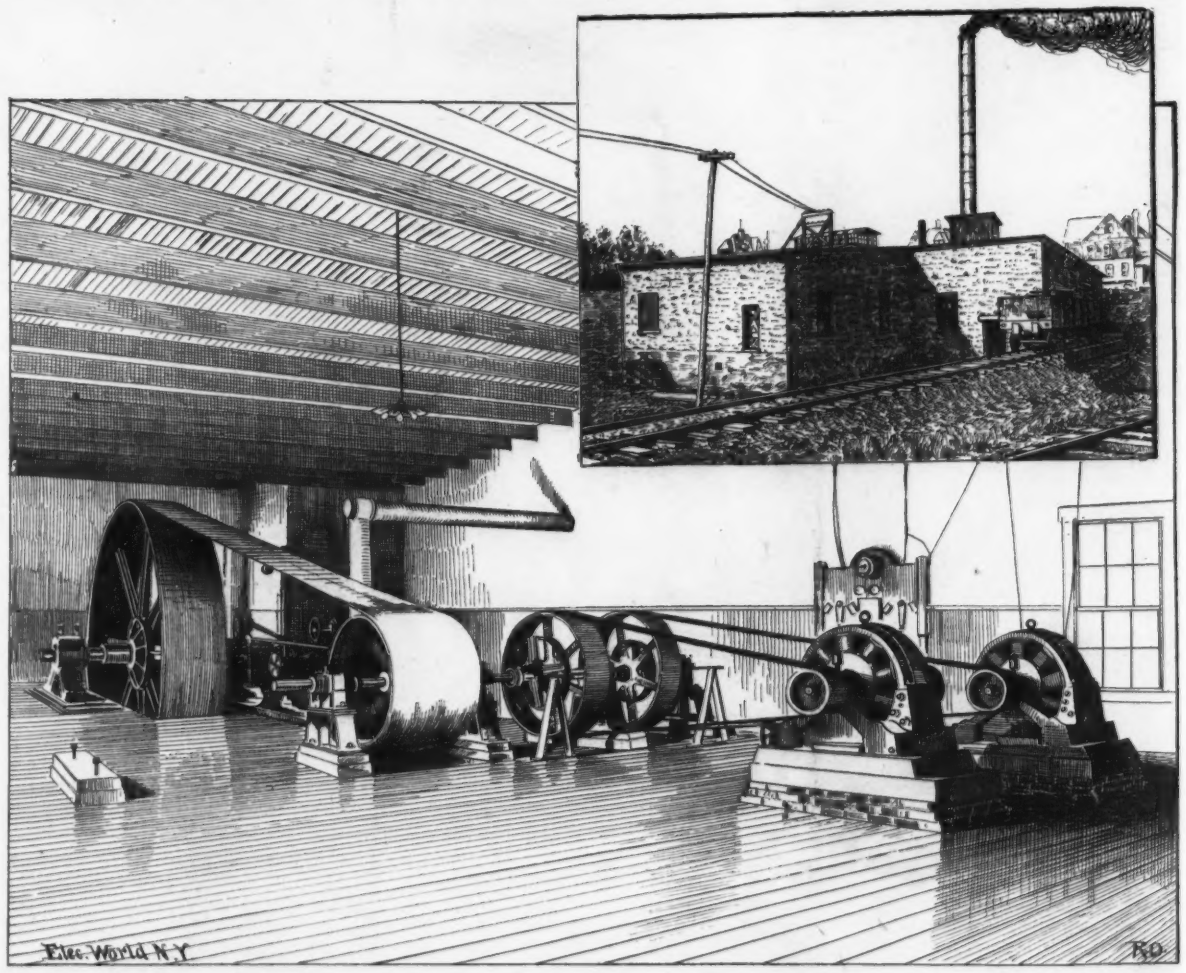
Mr. Charles Blanchard, of the Girard Building, Philadelphia, has recently put into operation the plant which he has erected for the Jenkintown (Pa.) Light Company, at Jenkintown Station, on the Philadelphia & Reading Railroad.

The sixteen miles of line construction already erected extend over the greater portion of Cheltenham township, and residences are already wired in Ashbourne, Ogontz, Glen Side, Edge Hill, Jenkintown, Rydal, Paulbrook, Betheyres, Fox Chase and Chelten Hills.

The plant—interior and exterior views of which are shown in the accompanying illustration—is equipped with a 250 h. p. Corliss engine of an improved type, built on special specifications, connected up with two 100 h. p. boilers, capable of maintaining 180 pounds pressure when the engine is fully loaded. Both the engines, boilers and foundations are so arranged that they may be duplicated when required. This duplication will be made by the addition of another engine connected on the same fly-wheel, and by the addition of two more boilers, space for which is provided for alongside those already installed. The foundations for the increased plant are already built, thus avoiding the usual reconstruction and greater expense.

The entire steam plant was built by Messrs. Robt. Wetherill & Co., Chester, Pa., under the supervision of Mr. Blanchard's consulting mechanical engineer, Mr. N. Williams. The entire electrical apparatus is furnished by the National Electric Manufacturing Company, of Eau Claire, Wis., whose transformer system for long distance lighting will furnish lights on circuits some of which are five miles in length. A 1,000-light dynamo is now in use, and another of 2,000-light capacity, for which the foundations are ready, will be soon in place. Ample floor space coupled with an ingenious arrangement of machinery makes the plant peculiarly easy to operate, and is such that should any part get out of order it can be cut off without disturbing the rest of the machinery. The shafting is furnished by Mr. George V. Cresson, of Philadelphia, and 200 feet of leather belting has already been purchased from Alexander Bros., Philadelphia; the piping and steam connections were erected by Kline Brothers. The pipe covering was made by the Ainsworth Boiler and Packing Company. The pumps were erected by J. G. Pulling & Co. and the injector by L. Schutte & Co. The line construction work was furnished by Mr. C. M. Blanchard, using the wire made by Messrs. Alf. F. Moore, Philadelphia, and the Electrical Supply Company, of Ansonia, Conn. All the lamps and sockets used by this company will be purchased from the Schaefer Electric Manufacturing Company, of Boston, which guarantees the life of its lamps at 1,000 hours, while the brilliancy of the lamps is unexcelled.

Danger from fire is guarded against by having the boiler house separated from the main building by an 18-inch stone wall; in fact, the whole building is built of stone and with little woodwork. The floor of the boiler room is brick laid on edge. The coal and supplies are delivered on a private siding laid up to the doors of the boiler room. Water can be had from three sources: the company's well on the grounds, a large creek running within 50 feet of the building, and the water-works of the town, whose stand pipe yields a plug pressure of 110 pounds.



ELECTRIC LIGHTING STATION AT JENKINTOWN, PA.

Electrical Distribution by Transformers from Central and Eccentric Stations.*

BY DR. J. A. FLEMING, M. A.

§ 13. *Westinghouse Transformers.*—The transformers or converters employed are illustrated in Fig. 34. The iron cores of the transformer consist of a pile of sheet-iron stampings, which are built up to encase the primary and secondary coils. The sheet-iron stampings are shown in Fig. 35. The cross-piece, or tongue, is bent back when the rectangle is slipped over the coils, and re-bent back into place, so as to fill up the centre aperture of the coils. Each of these coils is composed of double covered wire, coated

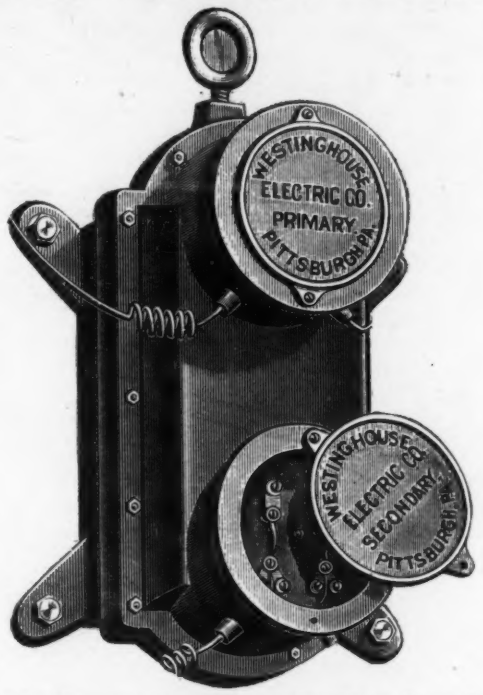


FIG. 37.—WESTINGHOUSE TRANSFORMER IN IRON CASE.

with an insulating compound, each layer of wire being insulated from its neighbor by additional insulation, and the completed coil covered with three separate and distinct coverings of insulating cloth. The contact between the primary and secondary coil is prevented by distance pieces

FIG. 34.—WESTINGHOUSE TRANSFORMER.

of insulating materials. The iron stampings are then piled up in and around the two coils (see Fig. 36), and the whole compressed by end-plates and tie-rods. The completed converter is enclosed in a cast-iron box, the two halves of which are bolted together with a waterproof joint (see Figs. 37 and 38). The ends of the primary and secondary coils are brought out to face plates under swing lids. There are the usual primary and secondary fuses, these being covered in with glass plates. The converter case has a ring and lugs by which it is attached to walls of buildings or to posts. A very usual practice is to affix the converter to the cross-arm of the post carrying the primary wires, or to the walls of a building (see Figs. 39A and 39B).

The converters are manufactured in four sizes for 500, 1,000, 1,500 and 2,000 watts output, or for 10, 20, 30, 40, 50-volt 16 c. p. lamps. It is generally the custom to employ the converters singly on separate secondary circuits, and not to bank them with secondaries in parallel on the same circuit, as it is considered that if the primary fuse of one condenser "blows," the additional load thrown on the other converters is apt to break down the whole set. The transformer generally used lowers pressure from 1,000 volts to 50 volts. Although the converters are very light, and have a smaller quantity of iron in the cores than might be considered desirable, they appear to be efficient in performance. Comparative tests made by the calorim-

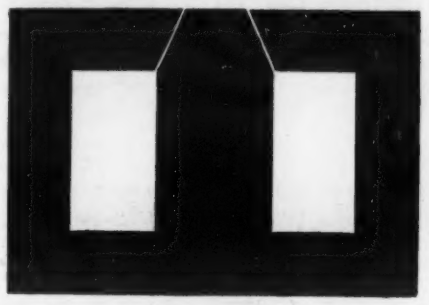


FIG. 35.—SHEET IRON STAMPING FOR CONVERTER.

eter method at the Electrical Testing Bureau of the Johns Hopkins University, U. S. A., in 1889, gave results as follows for the electrical efficiencies of these transformers at various loads:

EFFICIENCY OF WESTINGHOUSE CONVERTERS.

Capacity of transformer in 50-volt 16 c. p. lamps.	Power in watts supplied to primary circuit.	Output in watts on secondary circuit.	Watts lost.	Efficiency in per cent.
Full load—				
10 lamps	585.3	504.0	81.3	85.9
20 "	1,109.3	994.3	115.0	89.6
30 "	1,529.0	1,395.0	134.0	91.2
40 "	2,151.0	2,010.0	141.0	93.4
Half load—				
10 "	334.0	257.0	77.0	76.9
20 "	660.5	552.1	108.5	83.6
30 "	883.0	751.0	132.0	85.05
40 "	1,213.4	1,120.0	123.4	90.08

Prof. G. Forbes, employing the same calorimeter method on a 30-light transformer, obtained an efficiency of 95 per

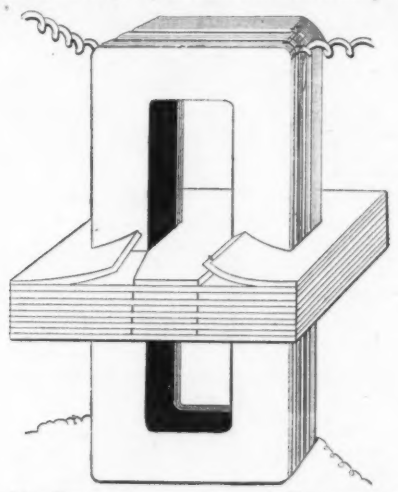


FIG. 36.—BUILDING UP CORE OF TRANSFORMER.

cent. at half load. The calorimeter method is, however, one somewhat difficult to carry out with accuracy, and such discrepancies in results are not unlikely to occur even between careful observers. Tests made by Mr. N. Marshall, at the Institute of Technology, Massachusetts, employing the calorimeter, and using a 20-light converter, gave an efficiency at full load of 93 per cent.* In this case the alternations were 14,530 per minute. Probably the

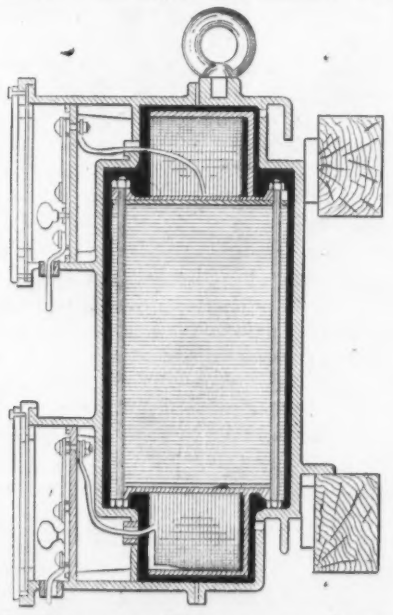


FIG. 38.—SECTION OF WESTINGHOUSE CONVERTER.

most complete tests on the efficiency of these transformers are those of Dr. Louis Duncan and Mr. W. F. C. Hasson, made in 1890 at the testing laboratory of the Johns Hopkins University, on a 750-light Westinghouse plant.† The dynamo was driven through a Tatham dynamometer by an Armington & Sims engine. Engine, dynamo and dynamometer were bolted down to heavy timbers, and the current conveyed to a bank of transformers of the 40-light size. These transformers supplied incandescent lamps. The efficiency of these converters was separately determined by a calorimeter method, by placing them in a metal box, with double walls, between which water was allowed to flow. The temperatures of the water at exit and entrance were observed, as well as the weight of water which passed through; at the same time the current and potential difference in the secondary circuit of the converter was measured. A series of corrections had to be applied for radiation. A 40-light and a 20-light converter were tested, with the results as under:

EFFICIENCY OF A WESTINGHOUSE CONVERTER, 40-LIGHT.

No. of lamps on.	Volts of lamps.	Watts in secondary circuit.	Loss in watts in transfo'er.	Loss in iron in watts.	Efficiency in per cent.
40	50.0	2,000	109	..	94.8
0	50.9	0	84	84	....

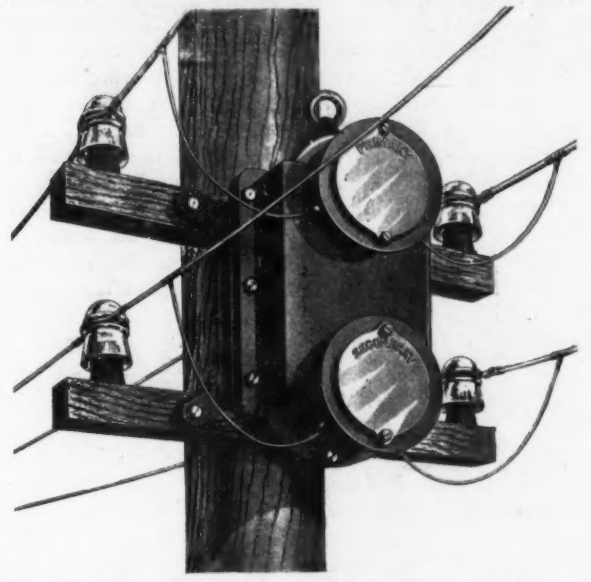


FIG. 39A.—WESTINGHOUSE TRANSFORMER AFFIXED TO CROSS-ARM OF POST.

EFFICIENCY OF A WESTINGHOUSE CONVERTER, 20-LIGHT.

No. of lamps on.	Volts of lamps.	Watts in secondary circuit.	Loss in watts in transfo'er.	Loss in iron in watts.	Efficiency in per cent.
20	48.8	952	106.0	95.2	90.0
15	52.2	817	114.8	108.9	87.6
10	50.3	506	101.7	99.2	83.3
5	51.44	264	109.4	108.7	70.7
0	52.3	0	110.5	110.5	0.

Experiments at slightly different primary potential differences showed that the loss in the iron varied very nearly as the square of the voltage.

The efficiency of the converters being determined, that

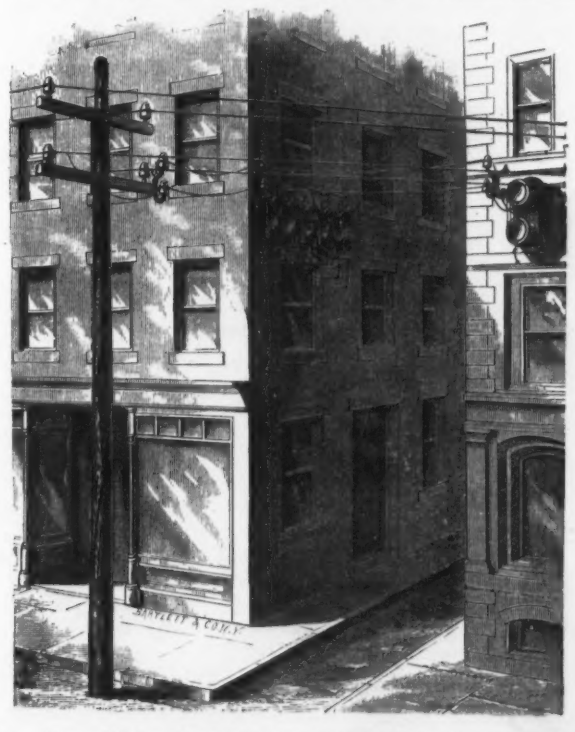


FIG. 39B.—WESTINGHOUSE TRANSFORMERS AFFIXED TO EXTERIOR OF BUILDINGS.

of the dynamo alone could be found. A series of experiments was made, in which the power supplied to the pulley of the dynamo was compared with the electrical power taken up in the lamps on the secondary circuits of the transformers, and as a result the net or over-all efficiency of the system determined. The lamp load was taken at one-quarter, one-half, three-quarters and full load, and the power determined.

TABLE OF EFFICIENCY OF 750-LIGHT WESTINGHOUSE PLANT AT VARIOUS LOADS.

Load.	Exciter		Primary circuit.		Sec'nd'ry circuit.		Horse-power in lamp circuit.	Power supplied to dynamo.	Loss in transformation.	Net efficiency, in per cent.
	E. M. F.	Current.	E. M. F.	Current.	E. M. F.	Current.				
One-quarter.....	105	9.4	1,107	10.0	49.5	153.9	10.21	21.83	11.62	46.8
One-half.....	104	10.5	1,107	18.9	49.6	338.4	22.5	34.4	11.9	65.4
Three-quarters..	101	11.0	1,113	28.6	50.0	520.7	34.9	48.0	13.1	72.7
Full.....	112	11.5	1,125	38.1	50 9	739.8	50.48	64.44	13.96	78.3

Looking at these figures, we see that there is even at no load only a small loss in the converters themselves, but

*Continued from THE ELECTRICAL WORLD, Oct. 25, 1890.

* THE ELECTRICAL WORLD, Vol. XV., Jan. 18, 1890, p. 46.
† THE ELECTRICAL WORLD, April 5, 1890.

there is a very considerable loss in the dynamo armature. The twenty 40-light converters supplying the 750 lights at full load absorb only some 2,000 watts, or about 3 h. p., when the secondary circuits are open; but since the total loss is at full load equal to 13 h. p., it follows that there is a loss of 10 h. p. in the dynamo at full load. From the above figures it appears, however, that at full load the commercial efficiency of the alternating dynamo in itself reaches somewhere about 86 per cent. Taking a commercial load diagram for the 24 hours, and reckoning the average diurnal or "all day" efficiency of such a 750-light plant, we find it to be about 60 per cent. That is to say, that if such a plant were continuously supplying incandescent lamps in ordinary houses 60 per cent. of the energy given to the dynamo in the 24 hours would be represented by electrical energy in the lamp circuits, and the rest would be dissipated in the machine and converters. In actual central station work good arrangements and proper selection of the size of unit machine would keep the working dynamo plant very nearly fully loaded at the various hours of the day, and a considerably higher average efficiency might be attained in the all-day use of such properly divided plant. Further reference will be made to the question of the reduction of the diurnal waste as far as regards the transformers and the relative advantages of transformer centres and large and small transformers.

(To be continued.)

The Electromagnet.*

BY PROF. SILVANUS P. THOMPSON, D. SC., B. A., M. I. E. E.

In order to make this question of leakage, and the relation of leakage to pull, still more incisive, I devised some time ago a small experiment with which a group of my students at the Technical College have been diligently experimenting. Here (Fig. 43) is a horseshoe electromagnet. The core is of soft wrought iron, wound with a known number of turns of wire. It is provided with an armature. We have also wound on three little exploring coils, each consisting of five turns of wire only, one, *C*, right down at the bottom, on the bend; another, *B*, right round the pole, close up to the armature, and a third, *A*, around the middle of the armature. The object of these is to ascertain how much of the magnetism which was created in the core by the magnetizing power of these coils ever got into the armature. If the armature is at a considerable distance away, there is naturally a great deal of leakage. The coil *C* around the bend at the bottom is to catch all the magnetic lines that go through the iron; the coil *B* at the poles is to catch all that have not leaked outside before the magnetism has crossed the joint; while the coil *A*, right around the middle of the armature, catches all the lines that actually pass into the armature, and pull at it. We measure by the means of the ballistic galvanometer and these three exploring coils how much magnetism gets into the armature at different distances, and are able thus to

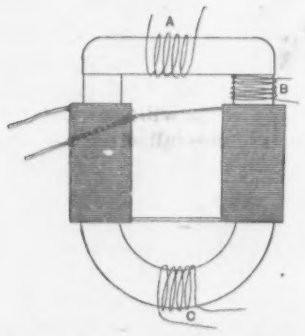


Fig. 43.—Experiment on Leakage of Electromagnet.

determine the leakage, and compare these amounts with the calculations made, and with the attractions at different distances. The amount of magnetism that gets into the armature does not go by a law of inverse squares, I can assure you, but by quite other laws. It goes by laws which can only be expressed as particular cases of the law of the magnetic circuit. The most important element of the calculations, indeed, in many cases is the amount of percentage of leakage that must be allowed for. Of the magnitude of this matter you will get a very good idea by the result of these experiments following.

The iron core is 13 millimetres in diameter, and the coil consists of 178 turns. The first swing of the galvanometer when the current was suddenly turned on or off measures the number of magnetic lines thereby sent through, or withdrawn from, the exploring coil that is at the time joined to the galvanometer. The currents used varied from 0.7 of an ampère to 5.7 ampères. Six sets of experiments were made, with the armature at different distances. The numerical results are given below :

I.—WITH WEAK CURRENT (0.7 AMPERE).

	A	B	C
In contact	12,506	13,870	14,190
Armature distance. 1 mm	1,552	2,163	3,786
2 mm	1,149	1,487	2,879
5 mm	1,014	1,081	2,028
10 mm	676	1,014	1,690
Removed	—	675	1,352

II.—STRONGER CURRENT (1.7 AMPERES).

	A	B	C
In contact	18,240	19,590	20,283
Armature distance. 1 mm	2,570	3,381	5,408
2 mm	2,366	2,839	5,073
5 mm	1,352	2,299	5,949
10 mm	811	1,352	3,381
Removed	—	1,308	3,041

III.—STILL STRONGER CURRENT (3.7 AMPERES).

	A	B	C
In contact	20,940	22,280	22,960
Armature distance. 1 mm	5,610	7,568	11,831
2 mm	4,557	6,722	9,802
5 mm	2,560	3,245	7,436
10 mm	1,149	2,704	7,098
Removed	—	2,365	6,427

IV.—STRONGEST CURRENT (5.7 AMPERES).

	A	B	C
In contact	21,980	23,660	24,040
Armature distance. 1 mm	8,110	10,810	17,220
2 mm	5,611	8,464	15,886
5 mm	4,056	5,273	12,627
10 mm	2,029	4,057	10,142
Removed	—	3,581	9,795

These numbers may be looked upon as a kind of numerical statement of the facts roughly depicted in

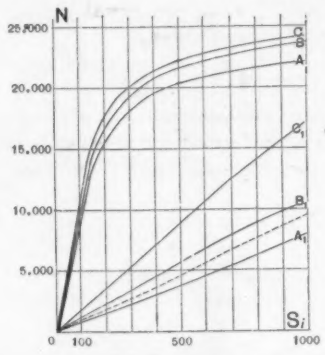


Fig. 44.—Curves of Magnetization Plotted from Preceding.

Figs. 31 to 34, on p. 284. The numbers themselves, so far as they relate to the measurements made (1) in contact, (2) with gaps of one millimetre breadth, are plotted out on Fig. 44, there being three curves, *A*, *B* and *C*, for the measurements made when the armature was in contact, and three others, A_1, B_1, C_1, made at the one millimetre distance. A dotted line gives the plotting of the numbers for the coil *C*, with different currents, when the armature was removed.

On examining the numbers in detail we observe that the largest number of magnetic lines forced round the bend of the iron core, through the coil *C*, was 24,040 (the cross-section being a little over one square centimetre), which was when the armature was in contact. When the armature was away the same magnetizing power only evoked 9,795 lines. Further, of those 24,040, 23,660 (or 98½ per cent.) came up through the polar surfaces of contact, and of those again 21,980 (or 92½ per cent. of the whole number) passed through the armature. There was leakage, then, even when the armature was in contact, but it amounted to only 7½ per cent. Now, when the armature was moved but one millimetre (*i.e.*, one-twenty-fifth inch) away, the presence of the air gaps had this great effect, that the total magnetic flux was at once choked down from 24,040 to 17,220. Of that number only 10,810 (or 61 per cent.) reached the polar surfaces, and only 8,110 (or 47 per cent. of the total number) succeeded in going through the armature. The leakage in this case was 53 per cent.! With a two millimetre gap the leakage was 65 per cent. when the strongest current was used. It was 68 per cent. with a five millimetre gap, and 80 per cent. with a 10 millimetre gap. It will further be noticed that whilst a current of 0.7 ampère sufficed to send 12,506 lines through the armature when it was in contact, a current eight times as strong could only succeed in sending 8,110 lines when the armature was distant by a single millimetre.

Such an enormous diminution in the magnetic flux through the armature, consequent upon the increased reluctance and increased leakage occasioned by the presence of the air gaps, proves how great is the reluctance offered by air, and how essential it is to have some practical rules for calculating reluctances and estimating leakages to guide us in designing electromagnets to do any given duty.

The calculation of magnetic reluctances of definite portions of a given material are now comparatively easy, and, thanks to the formulæ of Professor Forbes, it is now possible in certain cases to estimate leakages. Of these methods of calculation an abstract will be given in the appendix to this lecture. I have, however, found Forbes' rules, which were intended to aid the design of dynamo machines, not very convenient for the common cases of electromagnets, and have therefore cast about to discover some more apposite mode of calculation. To predetermine the probable percentage of leakage one must first distinguish between those magnetic lines which go usefully through the armature (and help to pull it) and those which go astray through the surrounding air and are wasted so far as any pull is concerned. Having set up this distinction, one then needs to know the relative magnetic conductance, or *permeance*, along the path of the useful lines, and that along the innumerable paths of the wasted lines of the stray field. For (as every electrician acccustomed to the problems of shunt circuits will recognize) the quantity of lines that go respectively along the useful and wasteful paths will be directly proportional to the conductances (or permeances) along those paths, or will be inversely proportional to the respective resistances along those paths. It is customary in electromagnetic calculations to employ a certain coefficient of allowance for leakage, the symbol for which is *v*, such that when we know the number of magnetic lines that are wanted to go through the armature we must allow for *v* times as many in the magnet core. Now, if *u* represents permeance along the useful path, and *w* the permeance of all the waste paths along the stray field, the total flux will be to the useful flux as $u + w$ is to u. Hence the coefficient of allowance for leakage v is equal to $u + w$ divided by u. The only real difficulty is to calculate u and w. In general u is easily calculated; it is the reciprocal of the sum of all the magnetic reluctances along the useful path from pole to pole. In the case of the electromagnet used in the experiments last described, the magnetic reluctances along the useful path are three in number, that of the iron of the armature and those of the two air gaps. The following formula is applicable,

$$\text{reluctance} = \frac{l_1}{A_1 \mu_1} + \frac{2l_2}{A_2},$$

if the data are specified in centimetre measure, the suffixes 1 and 2 relating respectively to the iron and to the air. If the data are specified in inch measures the formula becomes

$$\text{reluctance} = 0.3132 \left\{ \frac{l''_1}{A''_1 \mu_1} + \frac{2l''_2}{A''_2} \right\}$$

But it is not so easy to calculate the reluctance (or its reciprocal, the permeance) for the waste lines of the stray field, because the paths of the magnetic lines spread out so extraordinarily and bend round in curves from pole to pole.

Fig. 45 gives a very fair representation of the spreading of the lines of the stray field that leaks across between the two limbs of a horseshoe electromagnet made of round iron. And for square iron the flow is much the same, except that it is concentrated a little by the corners of the metal. Forbes' rules do not help us here. We want a new mode of considering the subject.

The problems of flow, whether of heat, electricity or of magnetism, in space of three dimensions, are not among the most easy of geometrical exercises. However, some of them have been worked out, and may be made applicable to our present need. Consider, for example, the electrical problem of finding the resistance which an indefinitely extended liquid (say a solution of sulphate of copper of given density) offers when acting as a conductor of electric cur-

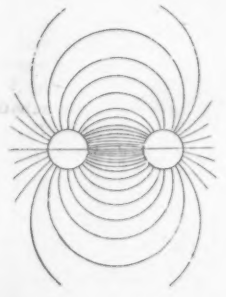


Fig. 45.—Curves of Flow of Magnetic Lines in Air from One Cylindrical Pole to Another.

rents flowing across between two indefinitely long parallel cylinders of copper. Fig. 45 may be regarded as representing a transverse section of such an arrangement, the sweeping curves representing lines of flow of current. In a simple case like this it is possible to find an accurate expression for the resistance (or of the conductance) of a layer or stratum of unit thickness. It depends on the diameters of the cylinders, on their distance apart, and on the specific conductivity of the medium. It is not by any means proportional to the distance between them, being, in fact, almost independent of the distance, if that is greater than ten times the perimeter of either cylinder. Neither is it even approximately proportional to the perimeter of the cylinders except in those cases when the shortest distance between them is less than a tenth part of the perimeter of either. The resistance, for unit length of the cylinders, is, in fact, calculated out by the rather complex formula :—

$$R = \frac{1}{\pi\mu} \text{ log. nat. } h;$$

Where

$$h = \frac{2a}{b + 2a - \sqrt{b^2 + 4ab}}$$

the symbol a standing for the radius of the cylinder; b for the shortest distance separating them; μ for the permeability, or in the electric case the specific conductivity of the medium.

Now, I happened to notice, as a matter that greatly simplifies the calculation, that if we confine our attention to a transverse layer of the medium of given thickness, the

*Cantor Lectures, No. 2, concluded from The Electrical World, Oct. 25, 1890.

resistance between the two bits of the cylinders in that layer depends on the ratio of the shortest distance separating them to their periphery, and is independent of the absolute size of the system. If you have the two cylinders an inch round and an inch between them, then the resistance of the slab of medium (of given thickness) in which they lie will be the same as if they were a foot round and a foot apart. Now that simplifies matters very much, and thanks to my friend and former chief assistant, Dr. R. Mullineux Walmsley, who devoted himself to this troublesome calculation, I am able to give you, in tabular form, the magnetic resistances within the limits of proportion that are likely to occur.

TABLE VIII.—MAGNETIC RELUCTANCE OF AIR BETWEEN TWO PARALLEL CYLINDRICAL LIMBS OF IRON.

$\frac{b}{p}$ Ratio of least distance apart to perimeter.	Magnetic reluctance in C. G. S. units = the magneto-motive force ÷ total magnetic flux.		Magnetic reluctance in inch units = the ampère-turns ÷ the total magnetic flux. Slab = 1 inch thick.	
	Reluctance.	Permeance.	Reluctance.	Permeance.
0.1	0.2461	4.063	0.0771	12.968
0.2	0.3404	2.938	0.1066	9.377
0.3	0.4084	2.449	0.1280	7.815
0.4	0 4328	2.161	0.1450	6.897
0.5	0 5084	1.967	0.1593	6.278
0.6	0.5479	1.825	0.1717	5.825
0.8	0.6140	1.629	0.1924	5.198
1.0	0.6681	1.497	0.2093	4 777
1.2	0.7144	1.400	0.2238	4.571
1.4	0.7550	1.324	0.2365	4.228
1.6	0.7903	1.265	0.2476	4.039
1 8	0.8220	1.217	0.2575	3.883
2.0	0.8511	1.202	0.2667	3.750
4.0	1.0500	0.952	0.3290	3.040
6.0	1 1710	0.854	0.3669	2.726
8.0	1.2624	0.792	0.3955	2.528
10.0	1.3250	0.755	0.4151	2 409

NOTE.—In the above table, unit length of cylinders is assumed (1 centimetre in columns 2 and 3; 1 inch in columns 4 and 5); the flow

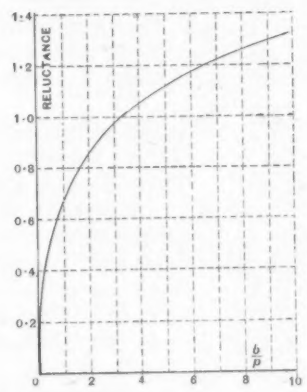


FIG. 46.—DIAGRAM OF LEAKAGE RELUCTANCES.

of magnetic lines being reckoned as in a slab of infinite extent and of unit thickness. Symbols: p = perimeter of cylinder; b = shortest distance between cylinders. In columns 2 and 3 the unit reluctance is that of a centimetre cube of air. In columns 4 and 5 the unit reluctance is so chosen (as in the rest of these lectures wherever such measures are used) that the reduction of ampère turns to magneto-motive force by multiplying by $4\pi \div 10$ is avoided. This will make the reluctance of the inch cube of air equal to $10 \div 4\pi \div 2.54 = 0.3132$, and its permeance as 3.1931.

The numbers from columns 1 and 2 of the preceding table are plotted out graphically in Fig. 46 for more convenient reference. As an example of the use of the table we will take the following :

EXAMPLE.—Find the magnetic reluctance and permeance between two parallel iron cores of one inch diameter and nine inches long, the least distance between them being 2⅜ inches. Here $b = 2.375$; $p = 3.1416$; $b \div p = 0.756$. Reference to the table shows (by interpolation) that the reluctance and permeance for unit thickness of slab are respectively 0.183 and 5.336. For nine inches thickness they will therefore be 0.021 and 48.02 respectively.

When the permeance across between the two limbs is thus approximately calculable, the waste flux across the space is estimated by muliplying the permeance so found by the *average* value of the difference of magnetic potential between the two limbs. And this, if the yoke which unites the limbs at their lower end is of good solid iron, and if the parallel cores offer little magnetic reluctance as compared with the reluctance of the useful paths, or of that of the stray field, may be simply taken as half the ampère-turns (or, if centimetre measures are used, multiply by 1.2566).

The method here employed in estimating the reluctance of the waste field is of course only an approximation: for it assumes that the leakage takes place only in the planes of the slabs considered. As a matter of fact there is always some leakage out of the planes of the slabs. The real reluctance is always therefore somewhat less, and the real permeance somewhat greater, than that calculated from Table VIII.

For the electromagnets used in ordinary telegraph instruments the ratio of b to p is not usually very different from unity, so that for them the permeance across from limb to limb per inch length of core is not very far from 5.0, or nearly twice the permeance of an inch cube of air.

We are now in a position to see the reason for a curious statement of Count Du Moncel which for long puzzled me. He states that he found, using distance apart of one millimetre, that the attraction of a two-pole electromagnet for its armature was less when the armature was presented laterally than when it was placed in front of the pole-ends, in the ratio of 19 to 31. He does not specify in the passage referred to what was the shape of either the armature or the cores. If we assume that he was referring to an electromagnet with cores of the usual sort—round iron with flat ends, presumably like Fig. 11—then it is evident that the air gaps, when the armature is presented sideways to the magnet, are really greater than when the armature is presented in the usual way, owing to the cylindric curvature of the core. So, if at equal measured distance the reluctance in the circuit is greater, the magnetic flux will be less and the pull less.

It ought also now to be evident why an armature made of iron of a flat rectangular section, though when in contact it sticks on tighter edgeways, is at a distance attracted more powerfully if presented flatways. The gaps, when

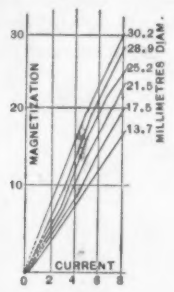


FIG. 47.—VON FEILITZSCH'S CURVES OF MAGNETIZATION OF RODS OF VARIOUS DIAMETERS.

it is presented flatways (at an equal least distance apart), offer a lesser magnetic reluctance.

Another obscure point also becomes explainable, namely, the observation by Lenz, Barlow and others, that the greatest amount of magnetism which could be imparted to long iron bars by a given circulation of electric current was (nearly) proportional, not to the cross-sectional area of the iron, but to its surface! The explanation is this: Their magnetic circuit was a bad one, consisting of a straight rod of iron and of a return path through air. Their magnetizing force was being in reality expended not so much on driving magnetic lines through iron (which is readily permeable), but on driving the magnetic lines through air (which is, as we know, much less permeable), and the reluctance of the return paths through the air is—when the distance from one to the other of the exposed end parts of the bar is great compared with its periphery—very nearly proportional to that periphery, that is to say, to the exposed surface.

Another opinion on the same topic was that of Professor Müller, who laid down the law that for iron bars of equal length, and excited by the same magnetizing power, the amount of magnetism was proportional to the square root of the periphery. A vast amount of industrious scientific effort has been expended by Dub, Hankel, Von Feilitzsch, and others on the attempt to verify this "law." Not one of these experimenters seems to have had the faintest suspicion that the real thing which determined the amount of magnetic flow was not the iron, but the reluctance of the return path through air. Von Feilitzsch plotted out the accompanying curves (Fig. 47), from which he drew the in-

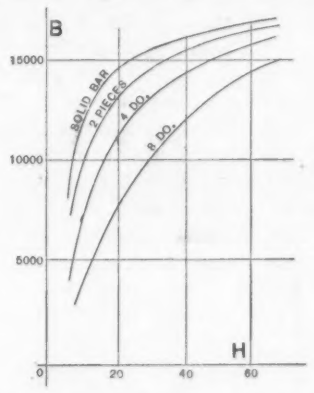


FIG. 48.—EWING'S CURVES FOR EFFECT OF JOINTS.

ference that the law of the square root of the periphery was established. The very straightness of these curves shows that in no case had the iron become so much magnetized as to show the bend that indicates approaching saturation. Air, not iron, was offering the main part of the resistance to magnetization in the whole of these experiments. I draw from the very same curves the conclusion that the magnetization is not proportional to the square root of the periphery, but is more nearly proportional to the periphery itself; indeed, the angles at which the different curves belonging to the different peripheries rise show that the amount of magnetism is very nearly as the surface. Observe here we are not dealing with a closed magnetic circuit where section comes into account; we are dealing with a bar in which the magnetism can only get from one end to the other by leaking all round into the air. If, therefore, the reluctance of the air path from one end of the bar to the other is proportional to the surface, we should get some curves very like these; and that is exactly what happens. If you have a solid, of a certain given geometrical form, standing out in the middle of space, the conductance which the space around it (or rather the medium filling that space) offers to the magnetic lines flowing through it, is practically proportional to the surface. It is distinctly so for similar geometrical solids, when they are relatively small as compared with the distance between them. Electricians know that the resistance of the liquid between two small spheres, or two small discs of copper immersed in a large bath of sulphate of copper, is practically independent of the distance between them, provided they are not within ten diameters, or so, of one another. In the case of a long bar we may treat the distance between the protruding ends as sufficiently great to make an approximation to this law hold good. Von Feilitzsch's bars were, however, not so long that the average value of the length of path from one end surface to the other end surface, along the magnetic lines, was infinitely great as compared with the periphery. Hence the departure from exact proportionality to the surface. His bars were 9.1 centimetres long, and the peripheries of the six were respectively 94.9, 90.7, 79.2, 67.6, 54.9 and 42.9 millimetres.

It has long been a favorite idea with telegraph engineers that a long-legged electromagnet in some way possessed a greater "projective" power than a short-legged one; that, in brief, a long-legged magnet could attract an armature at a greater distance from its poles than could a short-legged one made with iron cores of the same section. The reason is not far to seek. To project or drive the magnetic lines across a wide intervening air gap requires a large magnetizing force on account of the great reluctance, and the great leakage in such cases. And the great magnetizing force cannot be got with short cores, because there is not, with short cores, a sufficient length of iron to receive all the turns of wire that are in such a case

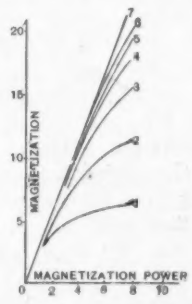


FIG. 49.—VON FEILITZSCH'S CURVES OF MAGNETIZATION OF TUBES.

essential. The long leg is wanted simply to carry the wire necessary to provide the requisite circulation of current.

We now see how, in designing electromagnets, the length of the iron core is really determined; it must be long enough to allow of the winding upon it of the wire which, without overheating, will carry the ampère-turns of exciting current which will suffice to force the requisite number of magnetic lines (allowing for leakage) across the reluctances in the useful path. We shall come back to this matter after we have settled the mode of calculating the quantity of wire that is required.

Being now in a position to calculate the additional magnetizing power required for forcing magnetic lines across an air gap, we are prepared to discuss a matter that has been so far neglected, namely, the effect on the reluctance of the magnetic circuit of joints in the iron. Horseshoe electromagnets are not always made of one piece of iron bent round. They are often made, like Fig. 11, of two straight cores shouldered and screwed, or riveted into a yoke. It is a matter purely for experiment to determine how far a transverse plane of section across the iron obstructs the flow of magnetic lines. Armatures, when in contact with the cores, are never in perfect contact, otherwise they would cohere without the application of any magnetizing force; they are only in imperfect contact, and the joint offers a considerable magnetic reluctance.

This matter has been examined by Prof. J. J. Thompson and Mr. Newall, in the Cambridge Philosophical Society Proceedings, in 1887; and recently more fully by Professor Ewing, whose researches are published in the "Philosophical Magazine" for September, 1888. Ewing not only tried the effect of cutting and of facing up with true plane surfaces, but used different magnetizing forces, and also applied various external pressures to the joint,

TABLE IX.—EFFECT OF JOINTS IN WROUGHT IRON BAR (NOT COMPRESSED).

H	B				Mean thickness of equivalent air-space for one cut.		Thickness of iron of equivalent reluctance per cut.	
	Solid.	Cut in two.	In four.	In eight.	Centimetres.	Inches.	Centimetres.	Inches.
7.5	8.500	6,900	4,809	2,600	0.0036	0.0014	4.	1.57
15	13,400	11.550	8,900	5,550	0.0030	0.0012	2 53	1.00
30	15,350	14,550	12,940	9,800	0.0020	0.0008	1.10	0.433
50	16,400	15,950	15,000	13,300	0.0013	0.0005	0.43	0.169
70	17,100	16,840	16,120	15,200	0.0009	0.0004	0.22	0.087

For our present purpose we need not enter into the questions of external pressures, but will summarize the results which Ewing found when his bar of wrought iron was cut across by section planes, first into two pieces, then into four, then into eight. The apparent permeability of the bar was reduced at every cut.

Suppose we are working with the magnetization of our iron pushed to about 16,000 lines to the square centimetre (*i.e.*, about 150 pounds per square inch, traction), requiring a magnetizing force of about H = 50; then, referring to the table, we see that each joint across the iron offers as much reluctance as would an air gap 0 0005 of an inch in thickness, or adds as much reluctance as if an additional layer of iron about one-sixth of an inch thick had been added. With small magnetizing forces the effect of having a cut across the iron with a good surface on it is about the same as though you had introduced a layer of air one six-hundredth of an inch thick, or as though you had added to the iron circuit about one inch of extra length. With large magnetizing forces, however, this disappears, probably because of the attraction of the two surfaces across that cut. The stress in the magnetic circuit with high magnetic forces running up to 15,000 or 20,000 lines to the square centimetre will of itself put on a pressure of 130 to 230 pounds to the square inch, and so these resistances are considerably reduced; they come down in fact to about one-twentieth of their initial value. When Ewing specially applied compressing forces, which were as large as 6 hundredweight to the square inch, which would of themselves ordinarily, in a continuous piece of iron, have diminished the magnetizability, he found the diminution of the magnetizability of iron itself was nearly compensated by the better conduction of the cut surface. The old surface, cut and compressed in that way, closes as it were magnetically up—does not act like a cut at all; but at the same time you lose just as much as you gain, because the iron itself becomes less magnetizable.

The above results of Ewing's are further represented by the curves of magnetization drawn in Fig. 48. When the faces of a cut were carefully surfaced up to true planes, the disadvantageous effect of the cut was reduced considerably, and, under the application of a heavy external pressure, almost vanished.

I have several times referred to experimental results obtained in past years, principally by German and French workers, buried in obscurity in the pages of foreign scientific journals. Too often, indeed, the scattered papers of the German physicists are rendered worthless or unintelligible by reason of the omission of some of the data of the experiments. They give no measurements perhaps of their currents, or they used an uncalibrated galvanometer, or they do not say how many windings they were using in their coils; or perhaps they give their results in some obsolete phraseology. They are extremely addicted to informing you about the "magnetic moments" of their magnets. Now the magnetic moment of an electromagnet is the one thing that one never wants to know. Indeed the magnetic moment of a magnet of any kind is a useless piece of information, except in the case of bar magnets of hard steel that are to be used in the determination of the horizontal component of the earth's magnetic force. What one does want to know about an electromagnet is the number of magnetic lines flowing through its circuit, and this the older researches rarely afford the means of ascertaining. Nevertheless, there are some investigations worthy of study to which time will now only permit me very briefly to allude. These are the researches of Dub on the effect of thickness of armatures, and those of Nicklès and of Du Moncel on the lengths of armatures. Also those of Nicklès on the effect of width between the two limbs of the horse-shoe electromagnet.

I can only now describe some experiments of Von Feilitzsch upon the vexed question of tubular cores, a matter touched by Sturgeon, Pfaff, Joule, Nicklès, and later by Du Moncel. To examine the question whether the inner part of the iron really helps to carry the magnetism, Von Feilitzsch prepared a set of thin iron tubes which could slide inside one another. They were all 11 centimetres long, and their peripheries varied from 6.12 centimetres to 9.7 centimetres. They could be pushed within a magnetizing spiral to which either small or large currents could be applied, and their effect in deflecting a magnetic needle was noted, and balanced by means of a compensating steel magnet, from the position of which the forces were reckoned and the magnetic moments calculated out. As the tubes were of equal lengths, the magnetization is approximately proportional to the magnetic moment. The outermost tube was first placed in the spiral, and a set of observations made; then the tube of next smaller size was slipped into it and another set of observations made; then a third tube was slipped in until the whole of the seven were in use. Owing to the presence of the outer tube in all the experiments, the reluctance of the air return paths was alike in every case. The curves given in Fig. 49 indicate the results.

The lowest curve is that corresponding to the use of the first tube alone. Its form, bending over and becoming nearly horizontal, indicates that with large magnetizing power it became nearly saturated. The second curve corresponds to the use of the first tube with the second within it. With greater section of iron saturation sets in at a later stage. Each successive tube adds to the capacity for carrying magnetic lines, the beginning of saturatio being scarcely perceptible, even with the highest magnetizing power, when all seven tubes were used. All the curves have the same initial slope. This indicates that with small magnetizing forces, and when even the least quantity of iron was present, when the iron was far from saturation, the main resistance to magnetization was that of the air paths, and it was the same whether the total section of iron in use was large or small.

I must leave till my next lecture the rules relating to the determination of the windings of copper wire on the cores.

Electric Motors for Elevators and Hoisting Apparatus.

The general public is now quite familiar with the use of electricity as a motive power, and well understands its convenience and cleanliness and its general adaptability to all classes of work where economy of space is a matter of considerable importance. As applied to the operation of elevators and electric hoists, the chief advantages of the electric motor as a source of power are economy, compactness, simplicity and durability, and the comparative noiselessness and smooth running of the elevator car or hoist, and its accompanying machinery.

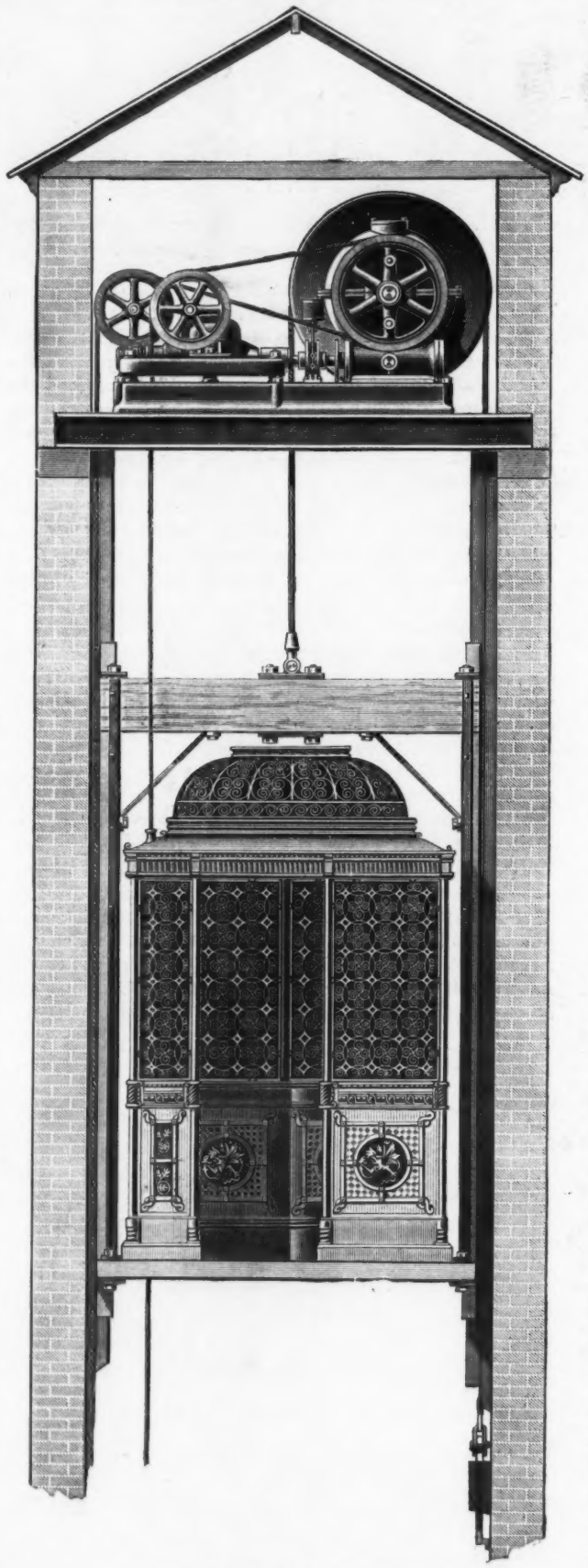


Fig. 1.—Electric Elevator.

The accompanying illustrations show in detail the application of the electric motor in the operation of the Electric Elevator Company's machines. The elevator machine of this company is remarkably compact, the average size occupying a floor space of six by four feet, and the machine is but four feet high. Owing to the small space occupied and the absence of vibration, the machine can be placed at the top of the elevator shaft, where it is entirely out of the way and occupies a space which would otherwise be of no value. The system is so arranged that when the machine is so placed at the top of the shaft the car is lifted directly from the drum, no sheaves being required. For this purpose a specially grooved drum is used, so made that the elevating cable winds and unwinds directly on the drum, and the pull on the car is always on a vertical plane.

The elevator machine, which in Fig. 1 is shown at the top of the elevator shaft, consists of the motor, worm gear, drum, reversing switch and rheostat combined, automatic electric brake and automatic stop device for stopping the elevator at the top or bottom of the lift, thus making it impossible for the elevator car to travel too far in either direction. The armature shaft of the motor is coupled direct to the worm shaft, and this coupling is also a brake wheel, to which the brake is applied automatically when the current is cut off, and thus not only serves the purpose of overcoming the momentum of the armature when stopping, but also serves to hold the car stationary, if through accident at the generating station, or from any other cause, the current should be cut off. The worm actuates the worm gear which is attached to the drum shaft. On the drum shaft, but not attached to it, is the wheel to which is attached the operating rope, the movement of which starts, reverses or stops the car at the will of the operator. The end of the drum shaft has a screw-thread cut on it, and on it travels back and forth a nut which has wings, and which, when it meets with any obstruction, turns with the drum shaft, and is so attached to the operating wheel by means of the wings that it turns the wheel just enough to stop the motor; the necessary obstructions to the travel of the nut are in the form of collars which are fastened to the shaft at just the right place to stop the machine at the top and bottom of the lift. The whole machine is assembled on one bed plate.

The elevator when operated by this machine makes very little noise and there is none of the disagreeable jerking of the car which is sometimes noticed when other methods of operation are used. The motors are of the slow-speed type, made specially for elevator service, so that it is possible to couple the worm shaft direct to the armature shaft and yet run the worm at a sufficiently slow speed to insure quiet and smooth running. The worm runs in an oil cylinder, so that it is constantly lubricated and requires a minimum of attention.

The particular features of this machine which secure for it a high degree of economy and efficiency are deserving of careful consideration. Leaving out of the question the matter of first cost, which varies greatly according to the carrying capacity, speed of the elevator car, and many other details, the most important question requiring attention is the cost of operation and the necessary expense for repairs. In any machine there will necessarily be some wear, but it is claimed that in this machine the parts are so constructed that the wear is reduced to a minimum. The armature shaft and worm gear are fitted with the most approved automatic oiling bearings, and the worm, which is of one piece with the worm shaft, is made of hard machine steel, the worm gear being a bronze composition ring which is securely fastened on a cast iron web. The effect of this arrangement is that the rubbing contact of the steel on the bronze composition produces a minimum amount of friction. The wear is very small and the bronze composition being much the softer metal gets all of the wear, and when worn out can be readily renewed at small cost. The lubrication by means of the self-oiling bearings is very constant and satisfactory. The brushes of the motor and the contact points of the reversing switch, which, of course, wear out occasionally, can be renewed at very small cost, as carbon points are used for both the brushes and the switch, and they are so arranged that they can be easily replaced. In case the motor is supplied with current from an external central station no coal is required and no ashes have to be handled and no firemen or engineers are required. The janitor or elevator boy can do all that is necessary for the care of the parts, which consists simply of occasional lubrication and a renewal of the carbon points when necessary. As the motor runs only when the elevator is in actual operation no current is used during the time the elevator is standing. This is quite an important consideration and is a very strong point in favor of the electric motor as a source of power for elevators. The time during which the average elevator is standing still is very much larger than is generally supposed and usually exceeds the time during which the current will be called into use. The fact that an electric motor develops only the power called for by the load which it is called upon to carry weighs very heavily in favor of the economy of the electric elevator. Suppose the lifting capacity of the elevator to be one ton, and the load actually carried to be one-half that amount, under ordinary circumstances about one-half of the current would be called for that would be consumed were the elevator load of its full capacity.

Some interesting statistics in regard to average loads carried by passenger elevators in business places have been gathered, and these show that for elevators making from 400 to 500 trips per day, and carrying at times as high as 10 or 12 persons, the average load per trip is 2½ persons, so that on an elevator with a maximum capacity of, say, 10 people, power is required for only one-fourth of that load. Regarding the rates for electric current which vary considerably in different cities and according to the capacity and location of the elevator, those given by Messrs. Brown,

McClure & Co., heavy hardware merchants of Boston, Mass., are of considerable interest. Their elevator has a capacity of 4,000 pounds, lifting at a speed of 60 feet per minute, and the cage is unusually large, having a platform eight by ten feet; the lift is six stories, and the machine is placed at the top of the elevator shaft. They pay by meter, and the total expense from June 15 to July 15 was $7.35. This remarkably low figure is due to the fact that the current was used but a small part of each day; it would be used say one minute to lift 60 feet, and then would stand for 20 or 30 minutes while the elevator was unloaded and reloaded. For an average high speed passenger elevator $50 per month is thought by the elevator company to be a reasonable rate.

Those who desire a high speed elevator with smooth running, but wish to save the space occupied by the cylinder, pipes and tanks—if the tank system is used—and the annoyance, heat, smell and dirt which usually accompany the use of steam, will find the electric elevator well adapted to satisfy these requirements. The Electric Elevator Company recommends that none but direct connected machines be used for high-speed elevators or for any elevator in which smooth running and the greatest economy are the results to be obtained, but in most cases where there is a line of shafting available, driven electrically or otherwise, and where perfectly smooth running is not required, or a speed of above 100 feet per minute is not necessary, belt elevators may be used to advantage.

When indirectly connected in this manner the drum on the machine is driven by a worm gear like the direct connected machine, but the worm shaft, instead of being connected to the armature shaft of the motor, has one fast and two loose self-oiling pulleys. This shaft is also provided with an automatic shaft brake to hold the load firmly when at rest, and to render the changes of motion more prompt. This machine is also provided with an automatic slack cable stop to prevent the unwinding of the cable if the car should be obstructed in its descent, and also with an automatic stop independent of the operating rope for the top and bottom of the lift.

The electric dock and ship hoist, also manufactured by this company, is entirely new, and its compactness, simplicity and efficiency are its most noticeable features. A 10 h. p. hoist is assembled upon a bed plate 5 feet 10½ inches × 2 feet 9¼ inches, and from the bottom of the bed plate to the highest point on the machine (the switch lever when in a vertical position) the distance is but 3 feet 7½ inches. It may be placed on an overhead platform if desired, so that it occupies no dock or deck room whatever.

Fig. 2 shows a perspective view of the apparatus; a plan view is shown in Fig. 3, and a sectional view in Fig. 4. The apparatus consists of an electric motor *A*, and coupled direct to the armature shaft *B* is a worm shaft, which, with the worm, is one solid steel forging; this worm actuates a bronze worm gear *D* and cast iron friction clutch *E*. This is attached to a solid steel shaft *F*, to one end of which is attached a hauling drum or winch-head *G*, and on the other end is cut a thread. On this thread is a cast iron handwheel nut *H*, which is supplied with steel handles on the inside of the rim, so placed in order that they will not catch in the clothing of or strike the operator, and the movement of this handwheel nut forces the loose drum *I* into contact with the friction clutch *E*, or withdraws it at the will of the operator. The worm runs in an oil cylinder, and the worm gear is inclosed in a cast iron casing *K*, which forms a bearing for the drum shaft *F* and the standard *L* which carries the other end of the drum shaft, and also carries the switch *M* and the switch lever *N*. The switch is completely inclosed in a cast iron box *O*, which excludes all dust and dirt, and prevents the possibility of any body coming into contact with it.

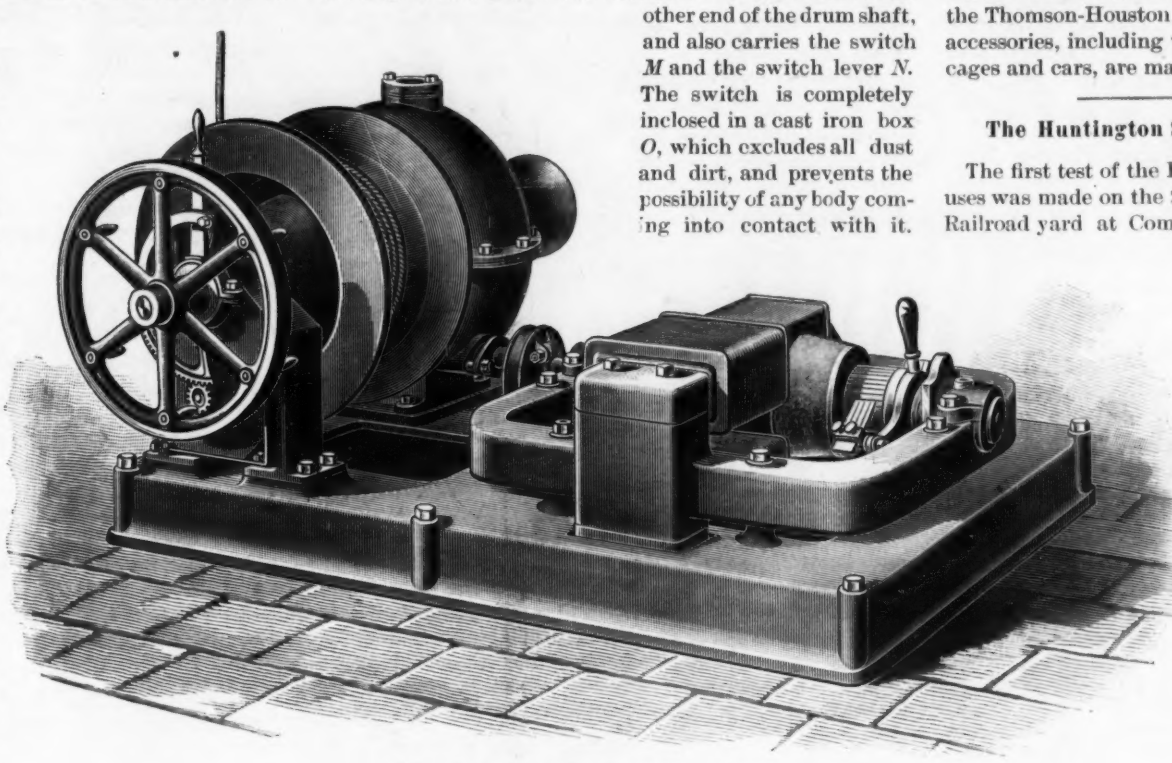


FIG. 2.—ELECTRIC DOCK HOIST.

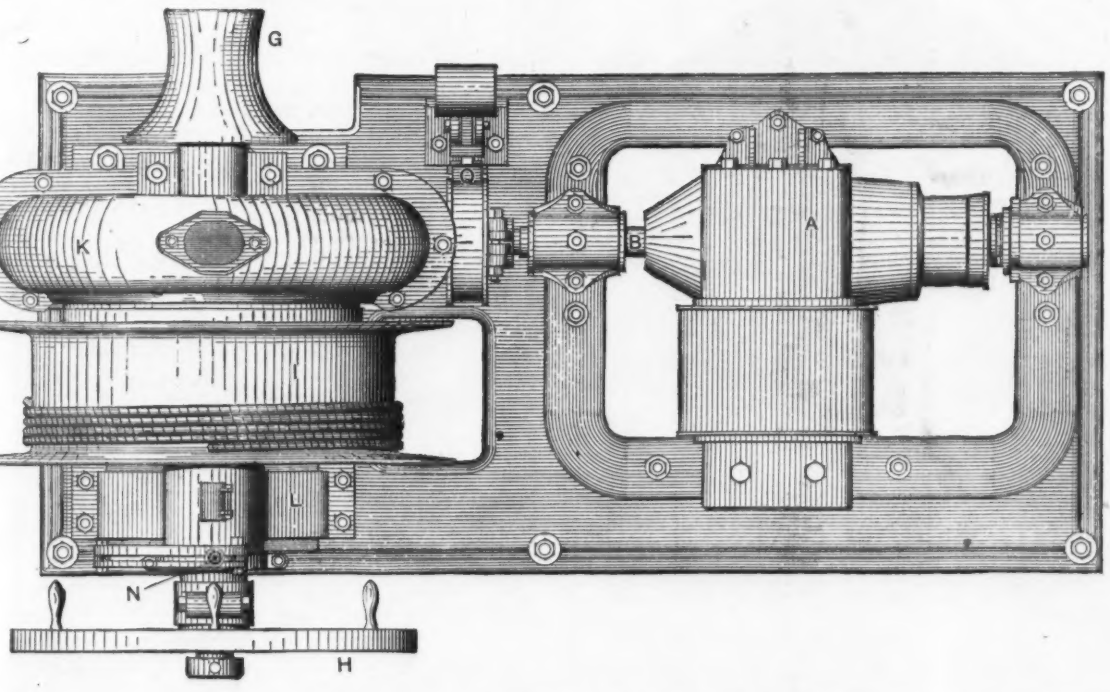
The rheostat or resistance box *P* is placed within the bed plate, and the connections are so made that there are no wires exposed, and injury to the wires from external abrasion is impossible.

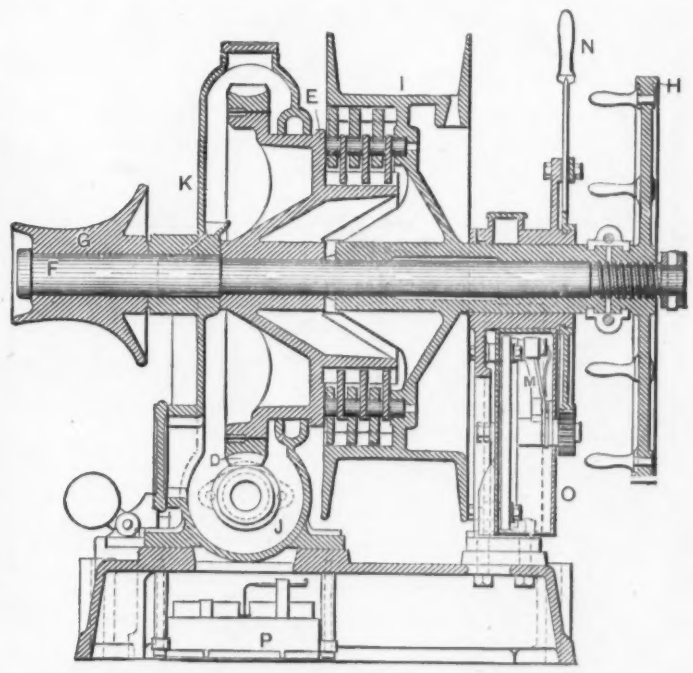
The method of operation is this: The operator moves the switch handle *N* to the left, which completes the electrical circuit and starts the motor; and as he continues to move the lever to the left he cuts out more resistance until full speed or the speed desired is attained. The drum shaft, winch-head and handwheel nut are now in motion, but the drum is still at rest. The winch-head *G* alone may now be used if desired, but if it is desired to use the hoisting drum *I* the operator places his hand upon the handwheel *H* and holds it stationary, which has the effect of screwing the wheel against the hub of the drum *I*, which is thus forced into contact with the friction clutch *E*, and when the pressure is sufficiently great to enable the drum to hoist the load the operator is no longer able to hold the wheel, which then turns with the drum until the load is lifted to the desired height, and the machine is then stopped by throwing the switch lever back to a vertical position, thus breaking the circuit and stopping the motor. The worm gear now holds the shaft with the friction clutch stationary, and the possibility of the worm being driven by the load is prevented by an automatic brake *Q* on the worm shaft. The handwheel *H* is connected with the hub of the drum *I* in such manner that, while each can turn independently of the other, the drum is moved back and forth on the shaft as the wheel is turned on the thread. To lower the load the operator moves the wheel *H* so as to withdraw the drum *I* from the friction clutch *E* until the load begins to descend by gravitation, and the speed of the descent is governed very closely by the handwheel. The positive connection between the handwheel and the drum is a much better arrangement than the more common one of having the drum forced out of contact by means of a powerful spring, for with the latter arrangement there is always a possibility that the spring will fail to work, besides which the operator always has the spring working against him in applying the friction.

All of the electrical work on these machines is done by the Thomson-Houston Electric Company, and all the other accessories, including wire rope, wire rope fittings, sheaves, cages and cars, are made by the Trenton Iron Company.

The Huntington Search Light on Locomotives.

The first test of the Huntington search light for railroad uses was made on the 22d ult. in the New Jersey Central Railroad yard at Communipaw. One of the lights was mounted on the switch signal bridge 20 feet above the track. The light had a capacity of 3,200 candle power. The reflector was the shape of the locomotive headlight reflectors and was made of copper, heavily silver plated and highly burnished. Superintendent Wheeler of the Central's electrical works conducted the experiment. Half a dozen electricians, including Dr. Scott of the Scott Electrical Works, witnessed it. The light was first turned on the depot, one-third of a mile away. It was almost possible to count the bricks in the building. Then it was directed along the tracks, and it was possible to count the ties to the depot, and the small stones that form the ballast could be distinguished. It was turned on every part of the yard, and at a distance of more than one-third of a mile the letters on the cars could be read with ease. The color of the paint on an old grain elevator half a mile away could be distinguished, as could also the color of the paint on the factory chimneys in Jersey City, more than half a mile off. When it was turned up the tracks toward the Communipaw station the light was so strong that if there had been even a small obstruction on the track at a distance of half a mile it could have been seen. The experiment was a complete success. There will be a more extended trial some day next week. The success of the search light of this company upon the Sound steamers has already been described in our columns. The progress of this new application will be watched with interest.





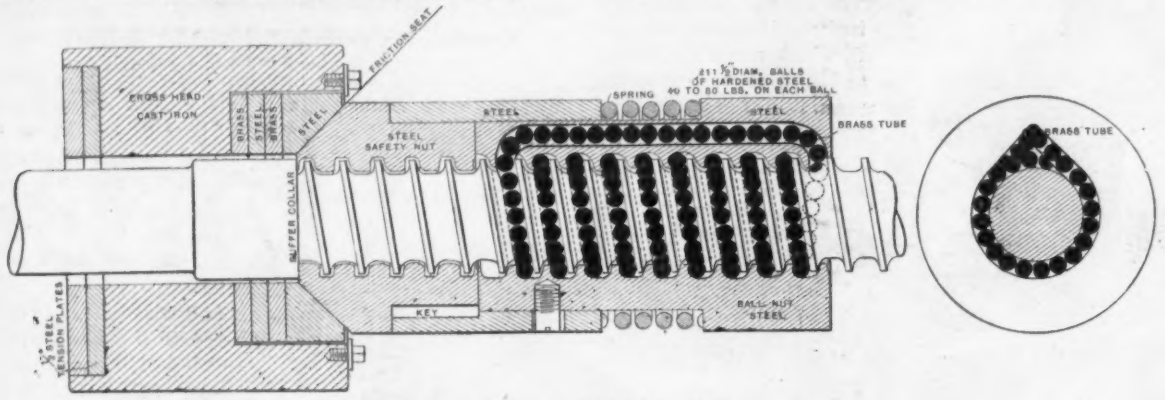
FIGS. 3 AND 4.—PLAN AND SECTION OF ELECTRIC DOCK HOIST.

A Remarkable Anti-Friction Screw.

The advent of the electric elevator has brought into prominence the screw gearing for elevator operation, which had for a time fallen into comparative disuse through the success of the hydraulic apparatus. The principal difficulty with the screw gearing has been an excessive amount of friction of the powerful screws in the necessarily massive nuts. In a recent design for an electric elevator—the nut and screw are shown herewith—this trouble has been very neatly avoided through the ingenuity of Mr. Charles A. Lieb, who devised for this and similar purposes the extraordinary ball-bearing nut which appears in the cut.

As will be at once seen, the arrangement consists in in-

erposing the hardened steel balls so much used in bearings between the open thread of the screw and the thread on the nut, so that instead of constant grinding action between the two the balls will roll easily around and relieve the surfaces in great measure of friction. A longitudinal by-path from end to end of the nut is provided so that the balls roll freely around the threads, and then back to the starting point. The cut shows in addition to this remarkable anti-friction device the safety thread which ordinarily is not in action, and the bearing devices appropriate to the screw gearing. The practical result of using this ball-bearing is to reduce the friction enormously, and consequently increase in a very large degree the efficiency of this particular method of transmitting rotary into rectilinear motion. If a screw fitted with this ball-bearing nut is held vertically, the friction is so slight that the nut will run down freely of its own weight, a very remarkable effect when it is considered that the pitch is not steeper than that shown in the cut and the screw several inches in diameter, and with nut of moderate weight. This is one of a series of similar anti-friction devices which have been invented by Mr. Lieb, all of which are characterized by very simple and ingenious application of the ball-bearing principle to every day use.



LIEB'S BALL BEARING NUT.

The Walker Ammeter and Voltmeter.

Although there is at present a very large number of measuring instruments for electric light stations upon the market, embodying in their construction a great variety of principles, the one which is herewith described is somewhat different from most heretofore brought into use. There can be no doubt that there is great need of a cheap and accurate instrument which is easily calibrated and the scale divisions of which are of equal length. An instrument which would seem to fulfill these conditions is illustrated upon this page. It is the invention of Mr. G. W. Walker, of this city, and in its construction he has made use of the principle which he has already utilized in his recording meter, described and illustrated some months ago in our columns. In its design Mr. Walker has endeavored to provide a meter containing the fewest possible number of parts, and these of the simplest character consistent with accuracy and durability, and at the same time to reduce the cost of construction to so low a figure that the instrument could be placed upon many circuits which are now unprovided with meters because of the large expense necessary in securing a satisfactory one.

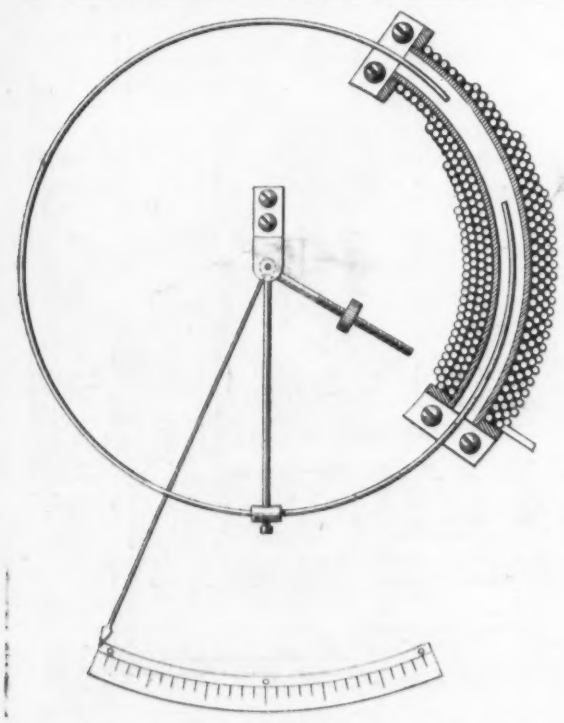


FIG. 1.—SECTION OF WALKER AMMETER.

Fig. 1 shows very clearly the construction of the meter and all of its parts. A solenoid magnet of arc shape is secured in position against a suitable support by means of screws. A circular core of iron, somewhat hardened, and extending over about 270 degrees of circumference, is carried upon a bar which is pivoted at the centre of the instrument and swings in jeweled bearings. The needle or pointer of the instrument is also carried upon this same axis, and extends outward beyond the core to the reading scale, as shown in the figure. An arm which is threaded to receive a nut-like weight, as shown in the figure, is carried from the same centre, and by means of this the core may be balanced so that when the instrument is not in circuit the pointer will stand at the zero of the scale. The solenoid is composed of a curved non-magnetic tube and a helix of insulated wire wound upon the tube, which serves only as a support, so that it tapers or decreases in diameter from one end to the other either gradually or by steps.

The core is made of comparatively hard iron, its free ends being joined by some non-magnetic material, such as brass, for the purpose of support so that the core may be kept in a perfectly circular form. The ends of the core are arranged so as to stand within the coil when in a normal position. The upward end, however, may be made to stand without the coil, but within the field of repulsion of the magnet, the other end standing when in a normal position at a point about midway the length of the coil. By using a core of small diameter it may be saturated by a slight percentage of the current used in the meter. The fact that the pointer moves over equal divisions on the scale for equal increments of current passed through the instrument is attributed by Mr. Walker to the fact that the core instead of being of soft iron is somewhat hardened, and also to the fact that the coil which exerts the attractive and repellant influence upon the core is wound in the tapering manner described above.

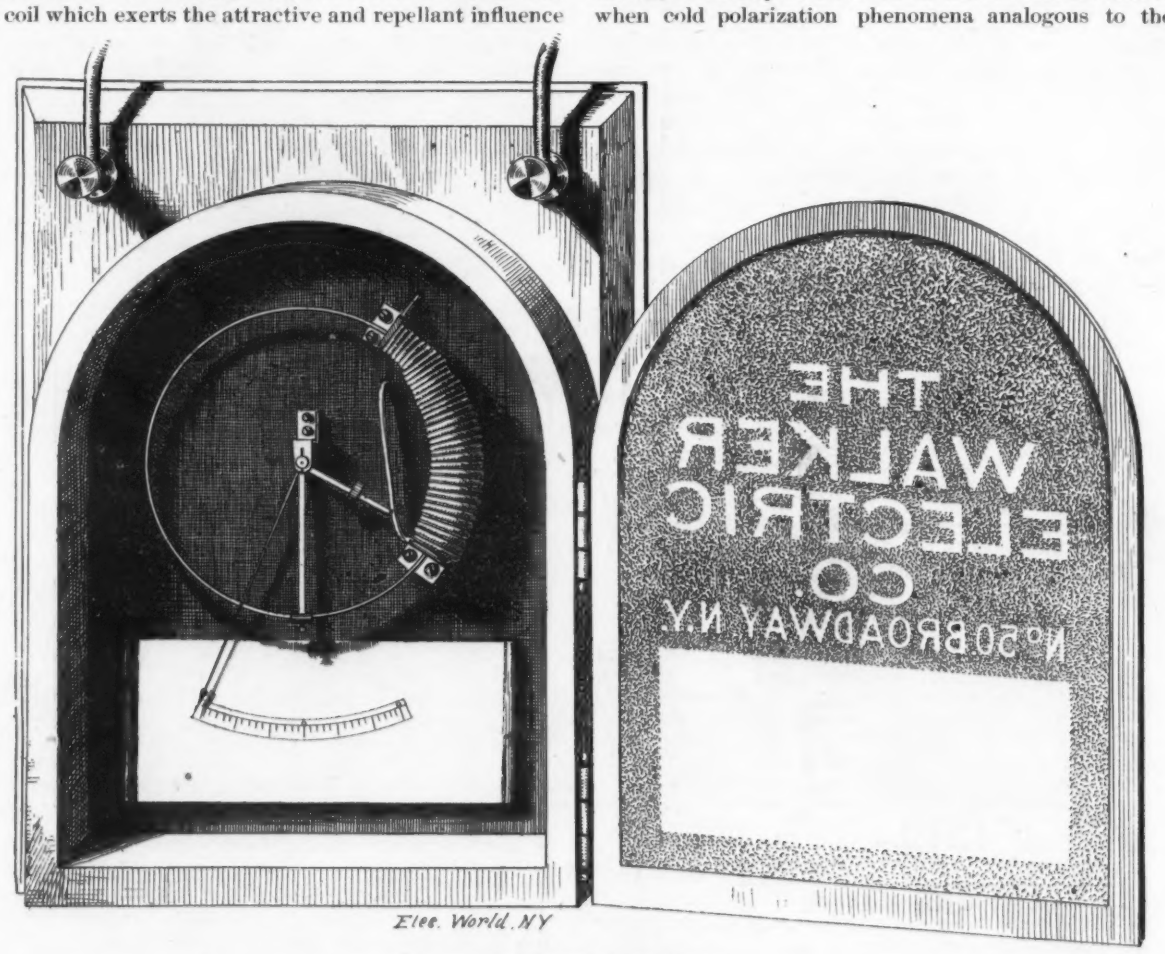


FIG. 2.—WALKER AMMETER.

Fig. 2 shows the instrument completed. The same construction, with the exception of the substitution of a fine wire of high resistance for the solenoid, makes the instrument a voltmeter instead of an ammeter, and both of these instruments are now made by the Walker Electric Co.

Tests of the Gulcher Thermo-Battery.

Some months ago* we published an account of an improved form of thermo-electric battery, due to Mr. R. J. Gulcher. The construction was very carefully arranged with reference to economy of fuel and securing the most uniform result, and, all in all, it may be taken as a very excellent type of the best modern thermo-electric batteries. It may be interesting now to add to what has heretofore appeared the following research on the electrical properties of this battery, recently published by Mr. Uppenborn in the *Elektrotechnische Zeitschrift*. The electromotive force of this battery depends on the consumption of gas and reaches its maximum about ten minutes after lighting the burners. Fig. 1 represents the electromotive force as a function of the time, and, as may be seen, it rises rapidly so that the battery is ready for action in a very short time. The relation between the electromotive force and the hourly consumption of gas is shown by the following table:

Consumption of gas in litres per hour.	Electromotive force.
215	3.64
250	3.90
258	3.97

A special experiment was made to detect any effect of polarization. The battery was short-circuited and the electromotive force then dropped several hundredths of a volt, but rose so rapidly again that it attained its normal value before the galvanometer needle had come to rest. The determination of the resistance of the battery has not given very definite results by reason of polarization. Approximately, however, it amounts to 0.39 of an ohm, cold. The resistance of the battery hot can be quite accurately determined from the electromotive force and the difference of potential obtained by inserting a known resistance. It has been shown during other experiments that it is possible to obtain very uniform results for this internal resistance by using external resistances differing widely in value. This shows that the polarization is very small when the battery is hot. As Waltenhofen has already shown, there may be observed in thermo-electric batteries when cold polarization phenomena analogous to those in voltameters. The following are the observations on the resistance:

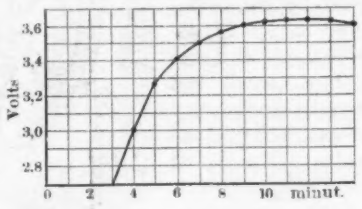


FIG. 1.—E. M. F. AS A FUNCTION OF TIME.

Consumption of gas.	Electromotive force.	Difference of potential with 0.7 ohm resistance.	Internal resistance.
215	3.62	215	0.48
215	3.62	217	0.47
215	3.60	212	0.49
250	3.90	235	0 461
258	3.95	235	0.46

These results show that there is a perceptible diminution of the resistance as the consumption of gas, and, therefore, the temperature increases. On the other hand, the resistance of the battery when cold is less than the values just given. It is probable that at the beginning of the heating the resistance increases rapidly and attains a maximum, and then decreases again. The maximum useful energy is obtained from a thermo-electric battery when the external resistance is equal to the internal resistance.

* The Electrical World, Feb. 8, 1890.

so if this latter is r and the electromotive E, the maximum work is $\frac{E^2}{4r}$. The useful energy deduced from the observations which precede is as follows:

Consumption of gas per hour.	Useful energy, in watts.	Gas per watt hour.
215	6.83	31.5
250	8.22	30.4
258	8.58	30.4

There may be added to these results some facts which have been communicated by Gulcher himself. He has found considerable difficulty in making the alloys used for the electro-negative element so as to obtain entirely uniform results, for it is hard to get the raw material always alike. It has been sought to remedy this by the use of chemically pure metals, but, unfortunately, these are inferior in thermo-electric properties to certain alloys. Harder even to avoid are the variations in specific resistance, which varies between the value of 14.4 and 36.6. These Gulcher batteries have been put to good use in nickel-plating, where they replace the inconvenient and variable primary battery with great advantage.

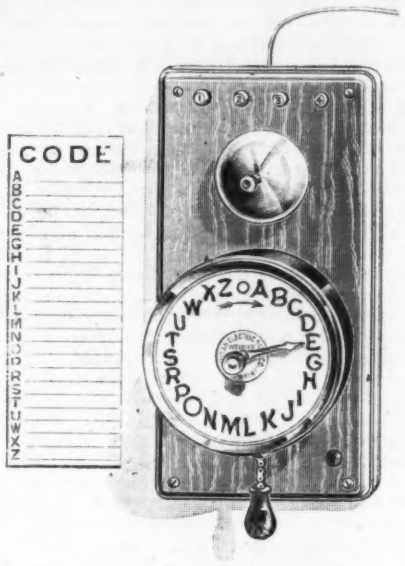


FIG. 1.—TELECALL SYSTEM.

The Westinghouse Railway at Greensburg, Pa.

Last week, the Greensburg and Hempfield Electric Railway Company, of Greensburg, Pa., started the operation of its street car line, which is equipped with the Westinghouse electric system. The road runs from the Pennsylvania railroad station through the principal streets of the town to Hempfield, a small suburb of Greensburg, a distance of two and a half miles. In covering this distance the cars have to climb no less than eight hills, and the majority of these incline at a grade of ten per cent. In addition to this, however, the line is also a difficult one on account of the large number of curves, all of them short ones, two being of a radius of 50 feet. But in spite of all these obstacles to an easy and smooth operation of the motors, it is worthy of note that they have given excellent and satisfactory service from the start.

Owing to the novelty of rapid transit in Greensburg, and especially of electrically propelled cars, the Greensburg residents have taxed the capacity of the cars to their utmost limit. Every car has been crowded from the starting point to the terminus and return, the cars having carried on the average 75 passengers.

The track is composed partly of the Johnstown rail and partly of the T-rail. With the exception of a short distance in the business portion of the town, where the tracks are laid on asphalt covered streets, the roadbed has been stone ballasted.

The power house is situated near the terminus of the road at the foot of one of the steepest hills along the entire route. It is very conveniently arranged. The car shed and a repair shop are immediately attached to it, everything being situated level with the ground. The motors are placed upon Brill trucks and the body of the car is made by the Chester Car Company. The latter are very commodious and handsomely painted.

Mr. F. Y. Clopper, a well-known Greensburg business man, has charge of the road and he expressed himself as being in every way satisfied with the equipment. The North American Construction Company did the construction work on the Greensburg road.

LUNKENHEIMER OIL CUP.

Economical Oil Cups.

Central station managers often find it to their advantage to change the oil cups sent out with some of the machinery they have purchased, and substitute therefore a cup that has proven practical, efficient and economical. Such a cup is the one shown in the accompanying illustration, and which is employed in many of the large stations recently constructed, and known as the new pattern Lunkenheimer sight feed oil cup for dynamo and motor work. As plainly shown, this cup is so constructed that when the desired feed is once set, it can be stopped or started instantly, the side spring acting as both indicator and lock. It is the usual practice to allow a heavier flow of oil just previous to starting the dynamos, in order that all the bearings may become well lubricated. With the Lunkenheimer cup this is easily accomplished by a slight turn of the milled head G, while a reverse turn shuts off the excess flow, and cuts in the normal feed. This cup, which is placed on the market by that old-established house, the Lunkenheimer Brass Manufacturing Company, of Cincinnati, O., can be opened, closed, filled and the feed regulated in the darkest room, so simple is its mechanism, a feature of great importance to many dynamo tenders.

The Telecall System.

A simple system of electrical calls which is capable of a more extended use than the ordinary call bell, and which by means of a number of arbitrary signals may be adapted to a great variety of uses, is shown in the accompanying illustrations. Fig. 1 shows the transmitter of the telecall system and Fig. 2 the receiver.

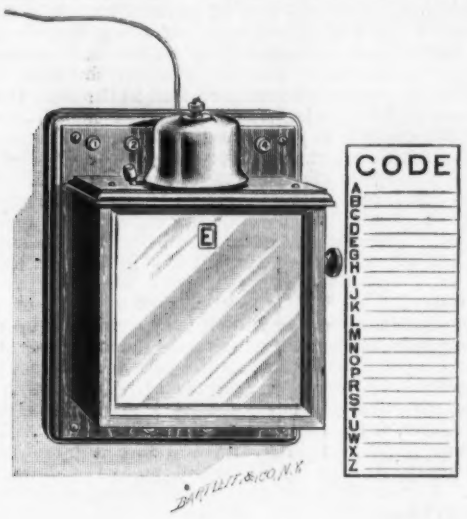
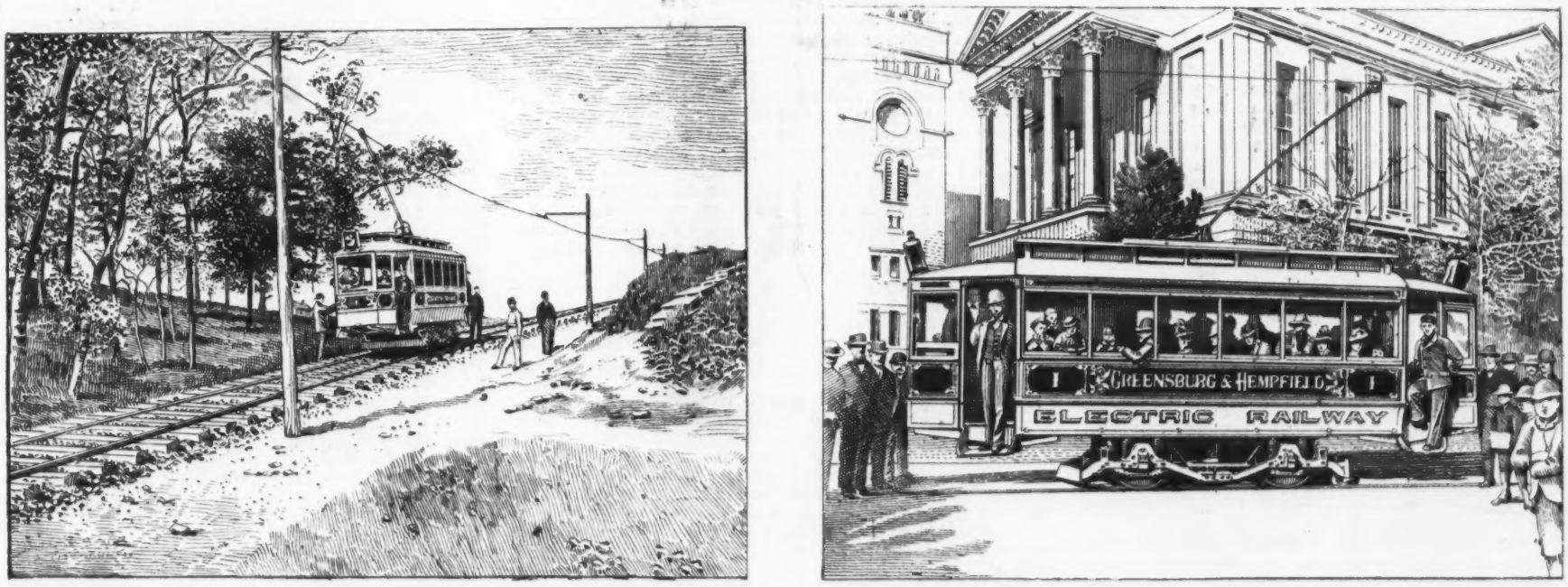


FIG. 2.—TELECALL SYSTEM.

The transmitter has on its face a dial containing 22 letters, and a pointer that can be turned to any letter. The receiver or indicator has a knob on one side, and accompanying each is a code on which are printed the 22 letters. These letters may represent persons, wants or sentences, at the pleasure of the parties using the instrument.

The operation of the system is very simple. Turning the pointer to the letter desired, the knob is pulled down full length and let go. Then the letter will immediately appear on the face of the receiver, accompanied by a ring of the bell. If the person at the receiver pushes the side knob, setting the receiver back to zero, this action will ring the bell at the transmitter, thus informing the sender that his message has been received. Should the person to whom the message is sent be negligent in responding, or momentarily be out of reach of the sound of the bell, he can be rung up by the party at the transmitter pushing the button on the latter instrument, which will cause the bell at the receiver to ring loudly, and yet not disturb the signal previously sent in.

The standard apparatus has 22 letters. It is made, however, with more or less letters if necessary, and for factory service it can be made with letters as large as desired and visible for a long distance. It can be run for ordinary distances with three Leclanché cells or their equivalent. If desired, dials can be used having words or names instead of letters.



WESTINGHOUSE ELECTRIC STREET RAILWAY AT GREENSBURG, PA.

The Civilian Electrician in Modern War.*

BY LIEUT. BRADLEY A. FISKE, U. S. N.

I beg to propose for your consideration this evening a plan by which, in time of war, all the electrical resources of New York, both in supplies and in men, will become at once available for the defense of the country and the city.

It is well known to all here that electricity has come into use as one of the great factors in warfare, both on sea and shore, not as an adjunct merely, as for lighting ships and forts, but as a vital element in the handling of weapons in actual battle and in the construction of new instruments, which accomplish things heretofore impossible.

I desire to recall to your recollection a few of the most important uses to which electricity is now put in warfare, to indicate some of the probable paths of future development to show that it would be impossible for our regular navy and army to adequately handle the vast electrical work which would have to be instantly done in time of sudden war, and to suggest a plan for coming to their assistance.

The science of electrical engineering is now recognized as one of the most necessary of the practical sciences of the world. It stands out as distinct and defined as the science of medicine, or the science of astronomy. It enters into thousands of the departments of daily life, but in no other department is it used in so various and so important ways as in warfare. This is so much the case that the prophecy is sometimes ventured that in the near future nations will fight by electricity. Though this, like all extreme statements, requires modification, yet the number of ways in which electricity has come to be applied within the last eight years is calculated to inspire the liveliest anticipations as to the developments of the next eight years. No vessel pretending to modern equipment goes to sea without a complete electric plant for furnishing light. This light is so much more suited to ship life than any other light that we now wonder that we ever went to sea without it. The electric motor is coming into use for ventilating ships, and it is beginning to be used for training guns and the hoisting to the deck of shot and shell. The best and the most accurate results at target practice are attained when the guns are fired by electricity. Range finders give the gunner constant knowledge of what he must know, *i. e.*, the distance of the enemy. The best means of night signaling and the one adopted in nearly every navy in the world, is by means of incandescent lights. The electric search light is almost as much a feature of the equipment of a modern war ship as are her guns and her torpedoes. In the actual use of the Whitehead & Howell torpedoes electricity plays an important part. The telephone is now coming into use for ship work, and will unquestionably supplant the speaking tube, which is acknowledged in all navies to be unsatisfactory. In fact, we find all through modern war ships an increasing use of electricity. The reason is clear. The modern war ship is the most intricate, tremendous and powerful machine existing. In no other equal space can be found so many, so various and so important kinds of apparatus. Everything must be done which will put her absolutely in the grasp of the captain. She must respond at once to his command, and her whole strength and power must be his, as though she were a part of him. Ensconced in his armored conning tower, he must be the brain of the gigantic body. Electric wires must convey instant tidings to him from her innermost recesses, and electric wires flash back from him the inevitable command. In this way only can a modern ship, no matter how large, how strong, how heavily armored, or how swift, completely fulfill her mission and be a perfect fighting machine.

What is true of ships is equally true of forts. The power of ships' guns has so increased that it has become necessary to protect shore batteries by iron and steel instead of masonry, as in the days not long gone by, and, in addition, to use disappearing carriages wherever it can be done. Disappearing carriages, as is well known, are so arranged that the gun disappears below the parapet of the fort when the gun is fired, and remains out of sight and safe during the operation of loading, so that it is exposed only for a short time when it is raised to fire. Now, without the aid of electricity, a very considerable time would elapse, even after the gun was raised, before it could be fired; because the gun would have to be trained in the proper direction and be elevated to the proper degree for propelling its projectile over the distance between it and the enemy. To estimate this distance and make the proper adjustments would entail delay, and would be absolutely impossible if smoke obscured the target, as would be the case during a great portion of the time. But electricity acting through the medium of the position finder gives the gunners continuous information of the distance and direction of the enemy, no matter how thick the smoke; so that they know exactly what to do before the gun is raised to fire.

Electricity furthermore gives the commanding officer complete control of all the different groups of guns and mortars in his fort. Noting the progress of the action from a station aloof from the smoke and noise, he can direct the concentration of as many batteries as he thinks best on one ship, or can disperse the fire as much as circumstances from time to time dictate.

For the handling of the monster apparatus used in forts, the guns, the carriages, the ammunition, electricity is rapidly coming to the front. Some power must be used, since the muscles of men are too weak. Hydraulic power has been used hitherto; but for many purposes electricity has the same advantages over hydraulics that have caused its unprecedented advance in the other departments of engineering throughout the world, while for repelling a night attack from ships the search light has been found by repeated trials in the naval manœuvres abroad to be simply indispensable to the land defense.

For military service in the field, there is not an army in the civilized world that has not its military telegraph service. One great cause of the suddenness and completeness of the German victory in 1870 was the rapid mobilization of the Prussian army, and its appearance on the frontier ready for battle. Now the splendid efficiency of the telegraph service in the hands of the military authorities made this possible. Nothing is more important in warfare than despatch in moving the enormous bodies of men, of which modern armies are composed, with all their ammunition, equipments and numberless accessories. To move a quarter of a million men to the frontier in a single day means a good deal; and to manœuvre so large a body of men with such precision and rapidity that no one division shall have to wait for any other division simply cannot be done without electricity.

But the most immediate and important use of electricity in the defense of a coast is in the submarine mine or ground torpedo. Defending a harbor with submarine mines is simply carrying out with more or less elaboration a system by which a large number of water-tight tanks, each holding from 100 to 1,000 pounds of gun cotton, or other explosive, are anchored in carefully defined positions and connected by armored electric cables, with protected operating rooms in which are batteries, measuring instruments, etc. The more complete mines have usually floating above them automatic circuit closers, in which two contact points are joined together by a passing ship, and thus afford a passage for the electric current to the fuse in the torpedo.

Now, these mines are some of them exceedingly large and heavy, and the electrical apparatus, while simple to the mind of a trained electrician, yet must be made and adjusted with great care. The torpedoes, as a system, must be constructed, laid down, and connected to the operating rooms on shore by long and heavy armored cables. The operation of practically planting and connecting the necessary submarine mines for New York would be a stupendous undertaking. Kindly bear this in mind until I recur to it again.

We have now seen, after a rough survey of the subject, that electricity has already acquired an acknowledged position in the art of war, and that the uses to which it is put are not trivial ones. Electricity is not used in warfare as a convenience, nor is it a fad of theorists; it fires the guns, it discloses the stealthy approach of the torpedo boat at night, it directs the proper elevation of the guns; in fact, it does good, honest, practical work. But note this point also: In every one of these applications of electricity we have to pay, in one way, for what we get, by studying the ways in which electricity will work for us. We cannot expect electricity to work for us unless we treat her properly. We cannot handle electrical apparatus with carelessness and ignorance and expect that it will work when we need it. In other words, we find in warfare, as in everything else to which electricity is applied, that electricians are useful. This remark doubtless seems absurdly commonplace, but it is intended to suggest that, in war time, electricians, even civilian electricians, may suddenly become very useful to the government. A captain of a fine ship might lose an action from simply a lack of knowledge as to some electrical appliance on his part, or on the part of some subordinate; some small accident might break a circuit just at a critical juncture, which might prevent the communication of an order, the receiving of information or the firing of a torpedo at a crisis; and yet the cause might be such that a man with even a very slight knowledge could remedy the difficulty in a second by the mere pressure of his finger; but that pressure not being given, the action might be lost, and from that cause alone.

Let us now glance at some of the other uses of electricity to which it would probably be put in case of an attack upon New York. There can be no reasonable doubt that Lay torpedoes, Patrick torpedoes, Sims-Edison torpedoes and Halpine-Savage torpedoes would come to the front at once. The enemy's fleet being daily expected off Sandy Hook, we should see the advocates of these systems, under authority of the general government, preparing stations at Coney Island, Sandy Hook and elsewhere for the launching of their dreadful missiles against his ironclads. The question of ballooning, both for observation and for the dropping of explosives on his decks, would be taken up at once, and the electrical world would be agitated anew over the question of balloon propulsion by electricity. Electric launches arranged to carry torpedoes would be fitted out to noiselessly steal out at night on their errands of destruction. Electric picket boats of smaller size, perhaps, would scout the waters in pursuit of information or to convey dispatches; electric submarine boats would spring into being by the dozen, and, filled with adventurous spirits, would seek the enemy, secure from detection below the surface of the sea and carrying enough explosives to utterly destroy the proudest war ship of the world.

It will now be apparent that, in the case of a sudden war (and most wars are sudden), there will be an immense amount of work to be done in the electrical line alone. Could our regular army and navy do all this work in the time allowed? It is probably known to all here that our regular navy and army are simply a nucleus around which fighting forces could be formed. They are so small as regards both officers and men that they can barely carry on the work in time of peace, and would be wholly inadequate in time of war. We should not have enough battle ships, monitors, cruisers or torpedo boats; we should not have enough forts; we should not have enough sailors; we should not have enough infantry; we should not have enough artillery; we should not have enough electricians. Take the single matter of laying out and connecting up the submarine mines in New York Harbor. This is an area covering many square miles, in parts of which the mines would be placed at frequent intervals, every mine being accurately secured in its designated place and connected by cable to the operating room, perhaps miles away. The mere labor of constructing, fitting and filling one mine, and afterward taking it out into the harbor and lowering it into place, with all its connections, is no small task; and what can be said of the task of doing this with hundreds of submarine mines? Then the work of properly arranging the various cable connections, testing apparatus, firing apparatus, etc., necessary for the efficient action of the mines would follow. The Board on Ordnance and Fortification have designed all the torpedo defences, but they will not be in practical operation, probably, for many years, and a war may come meanwhile. But it is certain that on the outbreak of any war an immense amount of this work would have to be immediately done, because we will never keep the submarine defenses of New York Harbor on a war footing in time of peace.

The Navy Department would even be more hurried. We should certainly be called upon to commission a great many war ships, and to equip as commerce destroyers a great many merchant steamships; we should have to do all the things that we did on the outbreak of our last war, and, in addition, we should be confronted with the necessity of fitting all kinds of fine apparatus, the necessity of fitting electrical appliances of all descriptions, besides securing gun circles in place with mathematical precision, and of accomplishing all the manifold fine work that is required with the ordnance, navigation and engineering equipment of a war ship of the present day. And as to fitting on merchant ships, who is going to fit them out? This operation requires technical knowledge. Who has it? How many of the merchant steamship captains would be able to install and manage a battery of even Hotchkiss or Driggs-Schroeder guns, or could remedy an accident to either gun or ammunition.

It being apparent that the regular army and navy in event of a sudden war would be unable to handle all the electrical work that would certainly be thrown upon them, I would propose the formation of a corps of naval and military electricians to assist the regular army and navy in its work. Such a corps might exist in every principal seaport town on the coast, the principal one, of course, being the corps with headquarters at New York. Electricity being now a recognized factor in both naval and military war, and requiring expert electricians for its full development, there would seem to be just as much reason for an electrical corps in the National Guard of the State of New York as for infantry, artillery or cavalry. While the members of this corps would be men of technical knowledge, and while its sphere of usefulness in war would be because of that technical knowledge, it is obvious that the organization should be a military one, and that with some modifications it should be governed by the same principles as govern all military bodies. Being a military body under the Governor of the State, it could at once become available on the outbreak of war.

It would seem that this corps, like all other corps, should be composed of men of various ranks, subject to various duties. Many kinds of work would have to be done in war, and many kinds of men would be required to do them. On the outbreak of war certain members would naturally elect duty in the navy, others in the army. The most obvious and immediate employment would, doubtless, be in the torpedo defense of the harbor, under the direction of the general commanding. And who can doubt the gratification which that general would feel, when suddenly ordered to defend New York harbor, on finding ordered to his list of subordinates a hundred or more capable electrical engineers, young, enterprising, accustomed to difficult electrical work, familiar not only with electricity in its technical features, but also acquainted with the electrical people of New York, with its factories, its places of business, and its methods of business? These men would become available in a day, and could be at once set to work in carrying out the details of the vast and complicated system. Their work need not be confined to that purely electrical in character, because every electrical engineer is by training and of necessity a mechanician, and every sort of apparatus would be readily understood by him, and a very slight training will make him master of it. Those members volunteering for naval work would be equally useful. The ordnance officer at the Navy Yard would suddenly find himself overwhelmed with a mass of work which he would be utterly unable to carry out without assistance of some such sort as this. And for the reason that electrical engineers are of necessity mechanicians, a great deal of technical work could be entrusted to them; such as the arrangement and fitting of gun carriages, the storage of ammunition, the assembling of guns, etc. Their more immediate and obvious field, however, would be the installation and fitting of electric lights, motors, telegraphs, telephones and other electrical appliances on board the vessels of war suddenly called into requisition. In the matter of fitting out merchant steamships their usefulness would be at once apparent. The number of regular officers would be found utterly out of proportion to the number of ships; the whole navy would have to undergo an expansion. Only a very few regular officers could be assigned to each vessel; so that the majority of officers would have to be volunteer officers, as was the case in our civil war. During the first part of the war the command of the different vessels would naturally be entrusted to regular officers, leaving the other positions to be filled by volunteers. Now as the commander of a ship is head of all the departments of a ship, he cannot give much personal attention to one special department. Therefore, the general arrangement and fitting out of all vessels, both regular war ships and merchant steamships, would have to be largely entrusted to volunteers in all that relates to the electric and ordnance equipments. Now as the work of fitting out ships with electric and ordinance equipments calls for technical knowledge and experience of a high character, it is obvious that a corps of well-trained technical men, such as here suggested, would be more than useful; they would be necessary. A further field for employment of such a corps in time of war is suggested by the fact that the genius of our people tends toward constant invention and improvement of all sorts of machinery and apparatus, and our history has shown that every war has brought into being many inventions in weapons of defence and offence. Can it be doubted then, that any future war would produce more such inventions? And in view of the great progress of electrical science since the last war, and in farther view of the great number of electricians in New York, can it be doubted that many of these inventions would be electrical in character? Under the stimulus of a national peril, and with the resources of New York at command, it is certain that important and novel warlike applications of electricity would at once spring into being. And while our regular forces of both army and navy were employed on their specific duties, what more natural than that some new Ericsson should arise and some new Monitor or other craft startle the nations of the world? Therefore, besides the obvious uses to which such a corps as this might be put, there are other uses no less important of inventing, constructing and using weapons of defense, the nature of which we cannot as yet even faintly conceive. And as few heroes of our late war go down to history with more glory than has Ericsson, so perhaps our next war may produce some electrician now unknown whose fame will outlive the ages.

It would seem as if such a corps as this could be formed under existing laws, and that there would be no difficulty in enlisting members. The attractions of the Naval Reserve and of the National Guard seem sufficient to induce a large membership in the different regiments, and there is no reason why membership in an electric regiment should not be equally desirable and confer equal distinction. The qualifications for entrance as regards education and intelligence would be greater than those for any other regiment, corps or battalion. Its military and naval usefulness would be acknowledged and its position in all respects would be one of dignity. The larger the membership the better; provided, of course, that due care be observed in excluding undesirable persons. The whole electrical influence of New York and of the country would be at its back, with all its

*Paper read at the meeting of the New York Electrical Society, Thursday evening, Oct. 23, 1890.

millions of dollars and its men of world-wide fame, and there is no reason why it should not acquire a national influence. The course of instruction could be readily carried out, embracing the naval and military applications of the purely technical science, with which the members are already familiar; instruction being given by regular navy and army officers detailed for the purpose. This instruction would naturally embrace the construction and care of apparatus. It being presupposed that there are different ranks in this corps, the system of instruction will naturally differ with the different ranks. With the higher ranks it would naturally embrace the theory and practice of gunnery and navigation, including compasses, and seamanship. Steam engineering would probably not need to be taught, it being assumed that the members require very little instruction in that branch. For the lower ranks, the scheme of instruction need not include much more than the handling and care of the different apparatus. On the outbreak of war, the members volunteering for the different services could be subjected to certain examinations, and their rank determined by the proficiency exhibited. As to the detail of organization, uni orm, etc., these need not be entered into here, as they can obviously be settled at any future time. My only purpose now is to propose to you a plan for meeting an emergency which may some day arise. I would hazard the suggestion that the corps or battalion should, at first, include about 250 members, and that it should be officered, uniformed and drilled in much the same ways as the other corps of the National Guard. I would even advocate a certain amount of infantry drill as a means of instilling the military idea. Occasional runs in the torpedo boat "Cushing," and frequent short trips out to sea for target practice in modern war ships would be essential. There would be considerable work, but there would be many compensating social and other advantages. I have ventured with much diffidence to advance this idea, but earnestly hope that you will think it worthy of earnest consideration. My only excuse for broaching it is that it has been in my mind for many years, that it has been commended by every man to whom I have spoken about it, and that I have been urged to bring it to the attention of the electricians of New York.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Oct. 27, 1890.

John A. Helvin, who has been nominated by the Prohibitionists of the Fifteenth Congressional District of New York, holds a prominent position in the New York Metropolitan Telegraph and Telephone Company.

Plant for the Brooklyn Navy Yard.—Plans and specifications for the new lighting plant which is to supply the Navy Yard with arc lights have been forwarded to Washington. The plant, it is estimated, will cost about $10,000.

Mr. George L. Wright, President of the River and Rail Electric Light Company, 45 Broadway, this city, has recently returned from an extended Western trip, and reports a growing demand for storage batteries throughout the West.

Lighting Plant for the "Vesuvius."—The work of putting a new electric light plant on board the "Vesuvius" was begun last week at the Brooklyn Navy Yard. The ship is to receive a new dynamo, new incandescent lamps and is to be rewired.

Have Purchased a Street Railway.—Mr. E. L. Hawks and Captain J. H. Barnard have purchased the Wilmington (N. C.) street railroad and will equip it with the electric system. These gentlemen are making their headquarters at 16 and 18 Broad street, this city.

The Long Island Railroad Company in Brooklyn is putting up a handsome brick building, 68 × 40 feet, for the use of an electric light plant to be operated by the company. Two engines and four dynamos will be put in, and there will be 61 lights about the yard and depot. The contract calls for the completion of the plant by Dec. 9.

A Visit to Edison's Laboratory.—The Count of Paris, with a party of friends, paid a visit one day last week to Mr. Edison's laboratory, where they were met by Mr. and Mrs. Edison, and while the Count was escorted over the laboratory by Mr. Edison the ladies of the party gathered in the library and were entertained by Mrs. Edison.

Gatling Guns Fired by Electricity.—For some time Commander C. H. McCormick, the ordnance officer at the Brooklyn Navy Yard, has been engaged in a series of experiments in the firing of Gatling guns which are revolved by a Crocker-Wheeler electric motor, and these experiments have proved so successful that they are to be continued at the Annapolis Proving Grounds.

Light for the Tower at Madison Square Garden — Mr. Edison is said to be superintending the construction of the electrical apparatus to be placed at the top of the tower of Madison Square Garden, in this city. The present plan is to follow somewhat the idea of the lighting arrangements of the Statue of Liberty, and it is expected that the light will be distinctly seen for ten miles.

A Subway Injunction.—The United States Electric and Power Company, the Brush Electric Illuminating Company, the Manhattan Electric Light Company, the Harlem Lighting Company and the United States Illuminating Company have obtained a temporary injunction from Judge Barrett, of the Supreme Court, restraining the Consolidated Telegraph and Electrical Subway Company from removing their cables and conductors, or interfering with their access to the subways.

A Concert Over the Wires.—In the transmitting room of the American Telephone and Telegraph Company, 18 Cortlandt street, this city, a concert was given one evening last week which was listened to by at least six audiences, one of which was in Philadelphia, one in Baltimore, one in Newark, N. J., another at the residence of General Superintendent Hibbard, in Morristown, N. J., and another at the home of Vice-President Sargent, in Brooklyn. In spite of the bad weather prevailing at the time the concert was a great success.

Mr. C. M. Wilder, of the Weir Frog Company, Cincinnati, O., was in the city this week, having just returned from a three months' tour in Europe. Just before his departure Mr. Wilder finished his electric signal devices, which are operated by 60 accumulator cells and a one-eighth h. p. motor, and after seeing them in successful operation went to Europe. While in this city he spent some time looking up new electrical inventions before returning to Cincinnati.

An Exhibition of Electric Batteries.—The department electricity of the Brooklyn Institute will make an exhibit of electric batteries of various forms in the large hall of the Union for Christian Work, 67 Schermerhorn street, on Friday evening, Oct. 31, from half past seven to ten o'clock P. M. The exhibit will include not only batteries in working order, but parts of batteries and appliances used in their manufacture. Parties desiring to take part in the exhibit should make application to Mr. James Hamblet, chairman of the committee on exhibits, 502 Fulton street, Brooklyn.

The Aerial Conduit Company, limited, with a capital of $35,000, has been incorporated by the Secretary of State at Albany N. Y. The company has for its objects the manufacturing and sale of conduits and tubing for electrical conductors and wires and other purposes, and posts and other supports for the same, together with supports for electric lights and wires, and insulated wire cables and other materials, and the doing of all things incidental to carrying on such a business in the city of New York. The incorporators are: John F. Gibley and Frank W. Rennell, New York City, and James Craig, Fred H. Smith, and Austin Gallagher, Brooklyn.

Estimates for Street Lighting for 1891.—The appropriation asked for lighting the streets of New York City for 1891 is $826,000, as compared with $700,000, the amount allowed for the present year. This increase was explained by Mr. Gilroy as being occasioned by the lighting of 1,100 additional gas-lamps, additional electric lights, including those shut off by the taking down of the wires, and the increased cost of electric lighting as shown by the bids lately submitted by the electric light companies. This increased cost is set down as amounting in the aggregate to $32,536. A resolution has been adopted by the Board of Estimate and Apportionment calling upon the Gas Commission to advertise for electric lighting bids at once for the year 1891, so that the Board may decide if the additional appropriation is necessary.

Exhibits at the American Institute Fair.—Among the interesting exhibits at this fair may be mentioned that of the Metropolitan Electric Signal Company, 45 Broadway, this city, which has in operation a complete installation of its telecall system, which is fully described elsewhere in this issue. James H. Mason, of 118 and 120 Park avenue, Brooklyn, has on exhibition a variety of Mason's "famous batteries," running lamps of from 1 to 25 c. p. He also has on exhibition fan motors run from a single cell battery, and a sewing machine motor of one-twelfth horse power driven by three cells of battery. Besides his battery exhibits, he also displays some general electrical supplies. L. J. Wing & Co., 80 John street, New York, have a very complete exhibit of disc fans ranging in diameter from 12 inches up to nine feet. These fans are driven by three methods—the gas engine, the steam engine coupled direct to the shaft and the fan, and the electric motor. All three styles are on exhibition. The gas engine used to drive these fans is the "Rollason," which is sold in this city by J. A. Harris, 10 Barclay street. Messrs. Jeffers and Kumberger have on exhibition a White & Middleton gas engine driving a C & C motor used as a dynamo, and the current thus generated is utilized to operate another C & C motor. Himmer & Anderson, 20 Vesey street, this city, have an exhibition of their batteries in sizes varying from 10 to 14 ampères capacity and showing electromotive force of 1.75 volts. The capacity of these batteries is said to be four ampère hours. Mr. F. L. Haviland represents the Clark Electric Company, and explains to visitors the merits of the Clark system of arc lighting for either high or low tension circuits. A very handsome lamp running on a Mather incandescent circuit is shown in operation, and attracts considerable attention. The Clark automatic safety devices are also exhibited, and their use and method of operation described to all interested parties. The exhibit is very handsomely arranged and very ornamental in appearance.

American Institute of Electrical Engineers.—The following associate members were elected at the Council meeting, Oct. 21, 1890: Arthur V. Abbott, mechanical engineer United Electric Traction Company, Closter, N. J.; J. Norman Bulkley, superintendent U. S. Aluminum Metal Company, Boonton, N. J.; Benjamin W. Colley, first assistant superintendent, the Commercial Cable Company, Hazel Hill, N. S.; Reginald A. Fessenden, assistant electrician, U. S. Electric Light Company, Newark, N. J.; Graham D. Fitch, first lieutenant Corps of Engineers, U. S. A., Duluth, Minn.; J. D. Gaines, second assistant superintendent, the Commercial Cable Company, Hazel Hill, N. S.; Robert McA. Lloyd, Electrician of the Marion (N. J.) factory, United Electric Traction Company, 2 West Thirty-sixth street, New York City; F. Martin, inspector of isolated plants, Edison Electric Illuminating Company of New York, 16 Oak street, Newark, N. J.; J. Martin, Electrician, Hanson, Van Winkle & Co., 16 Oak street, Newark, N. J.; Wm. C. Miller, general manager, Watervliet Turnpike and Railroad Company, 3 South Hawk street, Albany, N. Y.; Frank C. Perkins, student in electrical engineering, Cornell University, Ithaca, N. Y.; Thorburn Reid, consulting electrical engineer and expert, 15 Wall and 26 E. Thirty-third streets, New York City; E. M. Rosenberg, superintendent Manhattan Electric Light Company, Eightieth street and avenue B, New York City; Albert Schmid, superintendent Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.; Franklin Sheble, electrical engineer, Thomson-Houston Electric Company, Lynn, Mass.; Robert Watson, the Elektron Manufacturing Company, 79 Washington street, Brooklyn, N. Y.; Herbert Laws Webb, assistant electrician, the Metropolitan Telephone and Telegraph Company, 18 Cortlandt and 159 W. Ninety-fourth street, New York City; Harry W. Weller, railroad inspector, the Edison General Electric Company, Edison Building, Broad street, and Jamaica, N. Y.; John D. Wright, electrician's assistant, United Electric Traction Company, 107 Garrison avenue, Jersey City, N. J.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.,
BOSTON, Oct. 25, 1890.

Lawrence, Mass.—The Merrimac Valley Horse Railroad Company has received permission to use electricity on all its lines in Lawrence.

Providence, R. I.—Drake, Payson & Whittier have been appointed local agents for the Eddy motor, and already report several installations.

Mr. A. S. Vogt, master mechanic of the Pennsylvania Railroad, is in Boston for a few days, the guest of Walter G. Chase, of the Mason Regulator Company.

Laconia, N. H.—Robert G. Reilly, for two years superintendent of the Laconia Electric Light Company, has resigned his position to take effect Dec. 1.

The Jewell Belting Company, of Hartford, Conn., has equipped the Toledo street railway plant with a full set of its belting, the main belt being a 40-inch double one.

The Eddy Electric Company has now 194 motors in operation at Newark, N. J. Drake, Payson & Whittier have been appointed Providence (R. I.) agents for this company.

Windsor, Conn.—The Spencer Arms Company has completed its work and will remove its machinery from the building immediately to make more room for the Eddy Electric Company.

Change of Officers.—Mr. H. C. Spaulding has resigned his position as secretary and treasurer of the New England Electric Exchange, and Mr. T. W. Sprague has been elected as his successor.

Salem, Mass.—The Essex Street Railroad Company has asked for permission to change its system from the double trolley to the single trolley plan, and a hearing was ordered for the evening of Oct. 31.

To Use Electric Power.—The Springfield, Mass., Street Railway Company has voted to increase its capital stock from $300,000 to $700,000 for the purpose of introducing electricity as a motive power.

Whitman, Mass.—The East Side Electric Railway Company, of Brockton, has purchased the franchise of the local company, and work under the new management will be pushed as fast as possible.

Mr. C. W. Card, the well-known electrician with Kendall & Slade, will be married to Miss Elizabeth, daughter of Mr. and Mrs. James Davis, at their residence, 12 Everett street, Medford, Wednesday, Oct. 29, at 3 P. M.

Mr. Hector De War, for eight years with the Western Electric Company, and an expert on arc lamps and dynamos, will hereafter superintend the electrical department of the Russell Electric Lamp Company at Ballordvale, Mass.

Mr. A. C. Spaulding, general manager of the Thomson-Houston Motor Company, is giving his whole attention to the mining department of the company's work, and Mr. R. C. Wiggin has assumed the active management of the motor company.

The Shipman Engine Company is shipping to E Hall & Son, Honolulu, Sandwich Islands, two of its engines, viz., a one and a two horse power. The number one is to be used for charging storage batteries, and the number two for running a small dynamo.

The Holtzer-Cabot Company has recently installed at its factory in Brookline a 25 h. p. and a 3 h. p. Eddy motor to furnish power for manufacturing purposes. The company is now installing a 200-light Eddy dynamo which receives its power from the motors and furnishes light for the factory.

Bird & Sloane, the well-known wiring experts, have been pushed so with work that they have formed a new company called the Bird & Sloane Electric Construction Company, with the following officers: T. G. Howe, president; Roswell P. Smith, secretary; John F. Polsey, treasurer, with Bird & Sloane general managers. The capital stock is $30,000.

The gross earnings of the West End Street Railway Company in the year to Sept. 30 did not quite equal expectations, on account of bad weather in the last weeks of the period. They were in round numbers $5,680,000, against a hoped for sum of $5,800,000. But the actual figure shows an excellent increase of $430,000 over the previous year, an average gain of $1,178 per day for each day of the year, including Sundays, and the traffic is still increasing.

Inspector of Electric Wires.—An ordinance has been reported in the Boston City Council providing for the appointment of an inspector of electric wires and for electric wire regulation. The inspector when appointed is to hold office for one year from May 1. The salary of the office is fixed at $3,500 per year. One of the councilmen gave notice that he would offer an amendment to the proposed ordinance, fixing the inspector's salary at $5,000 a year instead of $3,500.

Providence, R. I., is to have an officer to be known as inspector of electric wires, and with a salary of $2,250. No one is to be eligible to the office who cannot pass a satisfactory examination before an examining board of electrical experts. The duties of the office will be principally the inspection and supervision of electric wires and conductors, and to make each year a report to the city council embodying such recommendations as may be thought necessary to increase the public safety.

The Russell Arc Lamp Company.—The syndicate controlling the Canadian patents of the Russell arc lamp have formed a new company called the Craig-Russell Electric Company, Limited, with offices at 180 St. James street, Montreal. All the old Craig patents and the new Russell patents are controlled by this company. Arrangements have been made with the Bell Telephone Company for the use of its poles through Montreal and franchises have also already been secured in seven other Canadian cities.

Providence, R. I.—We are very sorry to announce that Mr. John I. Drake, of Drake, Payson & Whittier, of Providence, while superintending the installation of an electric plant at the soap factory of the Kendall Manufacturing Company, Providence, some few days since, fell between the wheels of a moving truck that had just unloaded an engine, and received a compound fracture of the leg. Mr. Drake is very comfortable and improving very fast, although his absence is severely felt by his associates, who are rushed with work they had contracted for.

The Tropical American Telephone Company has just taken an order for over 110,000 feet of Okonite wire for export, and in addition has been preparing estimates for three large lots of multiple switchboards, also for export. The power of the Tropical American, through its sole right to manufacture and export telephone apparatus, and freeing the buyers from all United States royalties, has resulted in a large and increasing business in foreign countries. Large orders for Berliner's long-distance transmitters and the standard Tropical American telephone sets have been recently received.

Municipal Lighting at Peabody, Mass.—At the Massachusetts Supreme Court, last week, a hearing was given before Judge Holmes of the bill in equity brought by Willard Spaulding and other tax-payers of the town of Peabody, to restrain the treasurer of the town from paying out money under a vote of the town authorizing the establishment of an electric light plant. The case involves the right of a town to erect buildings and put in the necessary apparatus for the manufacture of electric light for sale to the citizens, or for its own use. The decision was reserved.

The Cohasset Electric Company, of Cohasset, Mass., has in operation a Thomson-Houston alternating dynamo, and is running 181 series 30 c. p. lamps. The steam plant consists of a Williams tandem compound condensing engine of 100 h. p., using a Deane condenser. The engine is supplied with steam from a Manning upright boiler, and with water by a Deane duplex pump. The company has orders for a large number of house, church and store lights, and is about to extend its lines into Scituate, and at the next town meeting expects to get the contract for 150 more lights. The Williams heater and purifier will be put in. Mr. O. W. Morrison, formerly chief engineer of the Consolidated Company's plant at Portland, Me., and also electrician at Bennington, Vt., is the superintendent of this plant.

The Standard Time Company of New Haven is installing in connection with the Seth Thomas Clock Company a new time plant for the Chicago and Northern Pacific Railroad at Chicago. The plant consists of a gravity escapement tower clock (Seth Thomas), with a bell weighing 10,000 pounds. This synchronizes a "Standard" regulator in the train dispatcher's office, which is connected with Warner's system of dials, of which there are 12 of 18

inch, and one 30 inch. The last named dial has polished gold numerals and hands, and the dial is of Tennessee marble. The Standard Company has granted a license to the United Electric Equipment Company for a city plant in Philadelphia. The company is also installing a plant for the Clyde Print Works, River Point, R. I., consisting of a regulator and 15 dials throughout the works.

The Fitchburg Gas and Electric Company have a very pretty station which was opened in December last. It is of brick, 116 × 46, two stories high, with space for machinery, etc., of double the amount now used. This company makes no effort to push the electric light, but has in use 165 Thomson-Houston arcs and 600 incandescent Thomson-Houston alternating, with a capacity for 200 arcs and 1,000 incandescents. The machinery consists of one 150 h. p. Putnam engine, with crank ready to attach another if necessary; two Fitchburg engines of 75 h. p. each; two 125 h. p. and one 100 h. p. Dillon boilers, and shafting all arranged for four more 50 arc machines if needed. The oiling arrangement is of much interest, as the oil is pumped to a tank and thence to the dynamos, and returns by gravity to the starting point. Thus a constant flow of oil keeps everything in good order. The company is constantly adding to its list of subscribers and bids fair to have a very large plant in the future.

Telegraph Offices at New Haven, Conn.—Manager Harris and Chief Operator Fairchild, of the Western Union Telegraph Company at New Haven, may well be proud of their new offices after so many years in the old one. The new arrangements constitute a rearranging of the old office, and transferring the operating room and battery room to the third floor. On the street floor is the delivery department, presided over as of old by the old reliable A. O. Bailey, assisted by a corps of clerks. On the inside is situated the manager's desk and desks for the bookkeepers. Around this is an artistic railing; and between this and the walls are benches arranged for the use of messengers when waiting to be called. A pneumatic tube connects the operating department with the delivery department and thus there is no delay in the service. On the third floor in the operating room are four sextette and two quadruplex tables, all nicely lighted by electricity. The switch case is the board lately in use at the Baltimore & Ohio office in New York, and is a model of beauty. The arrangement of the wires, of which there are 125 and which run through cables from the tower on the roof to the switchboard, is especially convenient, good light being secured on all sides and every wire tagged in regular order. Across the hall is situated the office of the superintendent of construction, J. McColiff, who has charge of the territory in Southern New England. Just beyond is the battery room, which occupies the room known as the old Adelphi Hall. In this room are 1,200 cells all arranged in alphabetical order (as are the tables) with a separate local for each table, thus avoiding the confusion of the old series cells. Taken altogether the Western Union Telegraph Company is in good shape now to handle its large increase of business at this point for years to come. L. H. H.

PHILADELPHIA NOTES.

Branch Office of the Electrical World,
31 City Building, Philadelphia, Oct. 25, 1890.

M. R. Muckle, Jr., & Co. are receiving bids for a 1,500 incandescent and 40-arc light central station plant for the Radford Land and Improvement Company of Radford, Va.

Rocksborough, Pa.—A charter has been secured for the building of an electric railroad from Rocksborough to Wissahickon. James Christie is president of the company, John Flanigan, secretary and treasurer, and the directors are: William Johnson, Peter P. Leibert, L. M. Jones, George C. Thompson and John Kinworthy.

A New Company.—A charter will be granted to the Diamond Electric Company, the object of which is to furnish the inhabitants of the city of Philadelphia light, heat and power by means of electricity. The petitioners are Charles A. Porter, William J. Latta, George A. Castor, David Martin, William W. Ker and James F. McLaughlin.

A Projected Electric Railroad.—The building of a new electric road from Reading, Pa., to Mohnsville, a distance of five miles, is now an assured fact. A meeting was held there last week and $50,000 subscribed. Mohnsville has half a dozen hat factories, and it is believed that the freight and passenger traffic of the road will be very heavy from the start. Work will be commenced at once.

A Big Electric Plant.—Work will be commenced at once on the new electric plant of the recently chartered company in the Twenty-third ward, whose charter gives franchises in the Counties of Philadelphia, Bucks and Montgomery. Among the incorporators are Hamilton Disston, Magistrate Thomas W. South, Charles A. Porter and Peter E. Costello. The building will be L shaped, built of brick three stories high, one 150 feet long and the other 100 feet long, each 54 feet wide in the clear. An engine of 1,000 h. p. will drive the machinery, and the whole will be complete within 90 days from the date of starting.

W. S. Griffith & Co., engineers and contractors, have commenced work on a large contract for the Kenilworth Inn Company, Asheville, N. C., where they are installing two large duplex plants of hot blast or fan system of heating; also one passenger hydraulic elevator, electric call bells and telephone; two 250-light Mather dynamos, and one arc light dynamo for lighting the grounds. The inn will be lighted only by electric lights. They are also installing two 70 h. p. boilers and power plant complete. It is the intention of the inn company to make this the finest equipped hotel in the South, and the engineering work will be the very best. W. S. Griffith & Co. have just completed a 150-light Mather plant for Burk Bros., Philadelphia. W. F. H.

WESTERN NOTES.

Chicago, Ill., Oct. 25, 1890.

The Card Electric Motor and Dynamo Company, Front and John streets, Cincinnati, is looking for some first class motor agents. The new catalogue of this company will soon be ready.

Mr. H. P. Broughton, the St. Louis representative of Chadbourne, Hazleton & Co., is a welcome visitor in Chicago this week. Mr. Broughton finds that the Wenstrom system of dynamos and motors is meeting with a cordial reception in the West, and expects soon to have several plants in operation.

The Cicero and West Chicago Electric Street Railway Company has been incorporated at Chicago to construct and operate electric street railways on West Forty-eighth street in Chicago and town of Cicero; capital stock, $1,000,000; incorporators, Joseph Feldman, Hiram Vanderpoel and James B. Heffernon.

Mr. G. E. C. Kohler, the Chicago representative of the Eddy Manufacturing Company, secured the contract for furnishing a 20 h. p. Eddy motor to Andrew Cummings, to be used in driving an Excelsior arc light dynamo, an application not often witnessed. Mr. Kohler has also sold a 1 h. p. Eddy motor to the United States Dental College.

The Illinois Steel Company ordered last month of the Western isolated lighting department of the Thomson-Houston Electric Company a 30 arc light plant for its works at South Chicago. This company has, during the past week, placed another order for a 35 arc light plant to be installed at the same place. This plant was delivered and set up ready for operation the day following that upon which the order was given.

Mr. Albert G. Corre, the receiver of the Novelty Electric Supply and Manufacturing Company, of Cincinnati, will probably be able to present his report to the court this week, and there receive his instructions for final disposition. Mr. Corre speaks highly of the loyal assistance rendered him by Mr. Morris and the other gentlemen connected with the establishment in the effort to save and maintain everything of value to the creditors.

Mr. Julius Andrae, Milwaukee, Wis., has secured the following contracts during the past two weeks: One 10-light Sperry arc plant, with ten 2,000 c. p. Sperry lamps complete, for the Northwestern Malleable Iron Works; one 10-light Sperry arc plant, with 1,200 c. p. Sperry lamps, to be installed in the malt kiln works of W Toepfer & Sons; one 150-light Mather dynamo, with full complement of lamps, etc., for the packing house of Fred Layton & Co., and one Mather incandescent plant complete for the Jos. Schlitz Brewing Company's new malt house.

Store Lighting.—Dernberg, Glick & Horner, Chicago, who were reported last week as having closed with the Thomson-Houston Company for a 45 arc light plant, have also been equipped with an incandescent light outfit. This concern has recently started a large department store to be known as the "Leader," and they evidently appreciate the value of the electric light, as besides purchasing isolated arc and incandescent plants, they have also contracted with the Chicago Arc Light and Power Co. for some arc lights to be suspended over the sidewalks, on both Adams and State streets.

Electric Lights for Hyde Park Houses.—The opening of the Hyde Park Electric Company's new power station at Fifty-third street and Illinois Central Railroad took place this week. This is the first station in Chicago designed to furnish electric lights for the purpose of lighting residences. The company, which has erected a plant capable of furnishing 15,000 incandescent lamps of 16 c. p., has been capitalized at $100,000. Its officers are: J. W. Brooks, president; H. N. Hibbard, vice-president; E. C. Ward, secretary and treasurer. The other directors are C. B. Bouton, F. E. Spooner, O. F. Lindman, and J. H. Ware.

An Interesting Plant.—The lighting plant which the Thomson-Houston Electric Company, through its Western isolated lighting department, has sold to Messrs Shailer & Schniglau for the Lake View water works, crib and tunnel at Chicago, will be unique in some respects, as the dynamo will not only supply electric lights at the water works on shore, but will be used to run an electric motor at the crib for ringing a fog bell, and will also supply a number of incandescent lamps in the lighthouse on the crib, to take the place of the oil lamps ordinarily used for such purposes. The dynamo plant will, of course, be placed on shore.

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$298@$300	Cumberland	$ 59@ $60
Central Union	56@ 57	Wisconsin	117@ 118
Michigan	94@ 96	Bell of Missouri	155@ 160
Great Southern	32@ 35	Iowa Union	20@ 21
Colorado	38@ 40	Missouri and Kansas	55@ 57
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$95@$100	Chicago Edison Co	$130@$132

The Chicago City Railway Company has, for some years, been using a Thomson-Houston incandescent dynamo for lighting its power house and offices near the corner of Twentieth and State streets, with such good economy and satisfaction that it has decided to adopt the same system for lighting its new power house at the corner of Sixty-first and State streets. It is much to the credit of President Holmes that he has been quick to avail himself of the many advantages afforded by the use of electricity, as indicated by his adoption of it on many of the street railway lines, outside of Chicago, in which he is interested, notably Rock Island, Davenport, Moline and Indianapolis, and also for the purpose of lighting his power houses.

Indianapolis, Ind.—The Citizens' Street Railway Company has 10 Thomson-Houston, five Short and two Julien cars equipped, and is running five Thomson-Houston and five Short cars on the Illinois street line. A friendly rivalry exists between the crews on the two systems in use on this line as to who has the fastest car. A correspondent says: "On the last trip in from the park at night they seldom have any passengers and the car drivers 'let them go.' The best time claimed by a Thomson-Houston motorman is 23 minutes. That record has been broken by a Short car cutting the time down to 21 minutes. When it is taken into consideration that this run is six and one-half miles, and that the line has eight curves, some of them the same as used in the old horse car system, it may be considered fast running." The two storage battery cars run out to Irvington and back, a round trip of 10 miles.

Power House at Minneapolis, Minn.—One of the huge engines at the Minneapolis electric railway power house is almost ready for operation. It has been tested, and gave satisfaction, and will furnish the power for the running of the cars as soon as some remaining machinery arrives. The engine just placed is a triple expansion condensing engine and has three cylinders, 24, 40 and 56 inches in diameter, respectively, each with a 60-inch stroke. The fly wheel is 28 feet in diameter and 73 inches across the face, weighing 45 tons, the whole weighing 200,000 pounds. It was manufactured by E. P. Allis, of Milwaukee. Two more exactly the same size will be placed in the power house, the foundation for one being already prepared.

Scott Focusing Lamp.—Mr. Martin Kruger, electrician of the Chicago Opera House and of the Duquesne Opera House of Pittsburgh, is using two of the Scott focusing lamps and lens in place of calcium lights in the comic opera of the "Merry Monarch." The lamps have given perfect satisfaction to every one, affording a clear white light without a particle of flickering and without the slightest hissing. The lamps may be placed in series or in parallel, as desired, and cost fully one-third less to operate than the calcium lights, even when the necessary current is taken from a central station circuit. If the current is secured from a private plant, or where all the desired light is included in the amount paid for rent, the saving effected is far greater.

Louisville, Oct. 24, 1890.

Mr. J. C. Lewis is about to install a 600-light incandescent dynamo of the Thomson-Houston type.

Louisville, Ky.—The R. B. Colton Lumber Company has installed a new 200-light Thomson-Houston dynamo which was recently put in operation.

Electric Lights in Kentucky Distilleries.—On account of a number of recent disastrous fires in Kentucky distilleries, a number of local distillers are discarding time-honored methods of lighting distilleries and warehouses. On account of the peculiar way in which whisky is allowed to ripen, or age, in the dark warehouses, it is seldom that lights are needed in the latter places, except to put in or take out whisky barrels from the racks or to cooper up defective barrels. Formerly it was the custom to use an open lard oil lamp. Then the underwriters had so many severe losses on account of the inflammable nature of the goods that they required that nothing but closed lanterns should be used. Even these were found not altogether safe, for frequently accidents resulted in spite of all precautions, as, for example, the recent destructive fires of the Allen-Bradley Company and of the Kentucky Distillery Company, both of which have been attributed to defective methods of lighting, and caused losses of about $2,000,000 or more. The result is that both underwriters and whisky men are seriously considering the innovation of electric lighting in all warehouses as well as distilleries. Already the Allen-Bradley Company here is rebuilding, and will adopt electric lights in its bonded warehouse. It has awarded a contract to the Gooch Electric Company here to put in two plants. The large distillery and warehouse here and a small warehouse at Frankfort, Ky., will require about 150 incandescent lights.

Cincinnati, Oct. 24, 1890.

At Findlay, O., the Westinghouse people are completing a four-mile railway line, with a two-mile extension.

The Colerain Avenue Electric Road began running the full length of its line—five miles—on Sunday. It has immediately jumped into a highly profitable business, becoming a rival of the C. H. & D. and the Bee Line railways between Connersville and in the city.

The Edison General Electric Company, which after a long fight in the courts for permission to lay conduits in the streets of Cincinnati obtained the grant, was on last Friday stopped from further proceeding by a resolution in Council, which appealed to the Attorney General of the State to bring quo warranto proceedings against the Edison Company. The purpose is to secure for all the electric light companies a common right to enter a general conduit.

Electric Railway Progress.—There is probably no city in the Union that has taken more enthusiastically to electric street railways than Cincinnati. The great majority of the residents of the city have been moving out upon the hills, and the suburbs, within the last five years, have nearly doubled in population. With the peculiar conformation of the territory much time was consumed in traversing short distances with horse cars. Four inclined planes, straight up the hills, bettered matters somewhat, and within the last three years three lines of cable road, aggregating 12 miles in length, have been doing a rushing business. But the first line of electric road, about a mile in length, running from Gilbert avenue, Walnut Hills, to the Reading road, Avondale, offered so many points of advantage—speed, ease and certainty, particularly—that the public at once pronounced in favor of electricity. The Daft motor was first used, and was soon followed by the Thomson Houston. The road now has a large patronage. Something over a year ago the Mount Auburn horse car line was altered to an electric road with the Sprague system. It immediately secured a large increase of business, particularly of travel to and from the Zoological Garden. The distance was some two miles. Shortly after, the Main street line was converted into an electric road, and the entire line from the Custom House to the Zoological Garden run by the new motive power. The Colerain avenue line is the latest enterprise in operation. The line runs about four miles from the Brighton House to the North Corporation line in Cumminsville. It is the double trolley system. Poles have been erected and wires strung to bring the road to Custom House Square, in the centre of the city. This will make the road the rival of the C. H. & D. R. R., and the Bee Line, and will, doubtless, take much of the steam lines' travel. Electric lines have been projected in all directions, and by next fall there will be few, if any, horse lines left. A line has been projected to run from the Custom House across the new Ohio River bridge to Newport. As that town now has 28,000 persons it will be seen that a large business can be counted on. This will serve as a rival to the Chesapeake & Ohio road. The Cincinnati & Covington line will be converted into an electric road in a few months. It is three miles long. The poles are erected for the line from the city to Avondale, four miles. The right of way has been obtained to continue this line to Carthage. It will probably not stop short of Wyoming, which is 13 miles from the city, via the C. H. & D. The people of Clifton, the most aristocratic suburb of Cincinnati, have secured an ordinance from the council for the construction of an electric road one and one-half miles long. It will be in operation in four months. The College Hill Electric Road has been incorporated and the rights of way obtained. The length of the line will be about five miles. It will be a rival to the Cincinnati & Northwestern Steam Railroad. The Mt. Adams & Eden Park horse car line will be operated by electricity after January. The line will be extended to O'Brienville, beyond East Walnut Hills, some three miles. The Consolidated Street Railroad Company, which controls all the downtown lines, is preparing to change to the new system. F. DEL.

SOUTHERN NOTES.

Norfolk, Va., Oct. 25, 1890.

Gallatin, Tenn.—Parties are contemplating the erection of an electric light plant.

Anniston, Ala.—The street car company will probably abandon mule power for electricity.

Athens, Ga.—This place will soon have telephonic communication with Harmony Grove, Ga.

Salem, Va.—The city council has contracted for the establishment of an electric light plant.

St. Clairsville, W. Va.—The city council invites bids for the erection of an electric light plant.

Bayou Goula.—An isolated electric light plant has been put into the sugar house of Maurice Haulon.

Darlington, S. C.—Several electric companies are competing for the erection of an electric light plant.

Winston, N. C.—A company has been organized to establish a telephone system between Winston and Salem.

Taneytown, Md.—An isolated electric light plant has been placed in the flour mill of Messrs. Zollicoffer & Bros.

Birmingham, Ala.—Electric light wires have been extended to the fair grounds, near the city, at a cost of $5,000.

Clayton, Ga.—A telephone line is being constructed to the Tallulah Falls, Ga. Nearly three miles of wire has been put up.

Elizabeth City, N. C.—An isolated electric light plant is being put into the lumber mill of Messrs. G. B. and T. W. Jones.

Cedartown, Ga.—An electric light plant is to be erected, and B. M. Davenport is securing estimates looking to that end.

Volcano, W. Va.—An electric power plant will probably be erected by W. C. Stiles, Jr., to furnish power for developing oil lands.

Hyattsville, Md.—J. H. Ralston and others are getting estimates on the cost of an electric light plant, and will probably erect same.

Macon, Ga.—The Ocmulgee Street Railway Company has been organized to build a street railway and will make it an electric line.

Greenville, S. C.—A $300,000-company is reported to have been organized by E. A. Buck and others to construct an electrical street railway.

Glasgow, Va.—The contract for establishing an electric light plant has been awarded to the National Electric Manufacturing Company, of Eau Claire, Wis.

Augusta, Ga.—The city council has been asked for permission to increase the speed of the electric cars from six to fifteen miles an hour in passing through the city.

Richmond, Va.—The electric street railway of the Southside Land and Improvement Company has been completed, and the cars made their first trip last week.

Lynchburg, Va.—It is stated that an electric power plant to operate a street railway is to be erected by the Virginia Power, Light and Construction Company.

Piedmont, Ala.—The new electric light plant will have a capacity of 6,000 incandescent lights. The wires are all up and the lights are expected to be turned on Nov. 1.

Opelika, Ala.—An electric light plant will be established by the Savannah and Western Railway Company, to light up the freight yard and passenger depot of this company.

Alexandria, La.—The City Council is reported to have awarded a contract to the Thomson-Houston Electric Company, of Boston, for the establishment of an electric light plant.

Waynesboro, Va.—The mayor invites bids until the 11th of next month for lighting the streets with 10 arc lights of about 2,000 c. p. A number of incandescent lights are also wanted.

Water Valley, Miss., has recently had an election to decide on issuing $10,000 of bonds for the establishment of an electric light plant and other improvements. The election resulted favorably to the issue.

Changing Places.—Mr. H. H. Jackson, the assistant manager of the Southern Bell Telephone Company, at Atlanta, Ga., has resigned that position to accept a place with the Thomson-Houston Electric Company.

Anderson, S. C.—The Western Carolina Land and Improvement Company, under whose auspices the new town of Calhoun Falls will be built, is obtaining estimates on the cost of an electric light plant. The same company contemplate the establishment of an electric street railway later on.

New Castle, Va.—Among a large number of enterprises projected at this point are companies with $50,000 and $25,000 capital stock, respectively, to establish an electric street railway and an electric light plant furnishing both arc and incandescent lights. The Junction Land Company can give particulars.

Louisville, Ky.—The Central and City street railways recently consolidated, and are now operated by one company. Electricity has been substituted for the old motive power. They have built a power plant which contains six dynamos and six engines. This company is also building in another part of the city a five-story electric power building.

Richmond, Va.—The two electric lines operated by the Southside Land and Improvement Company, and the Richmond & Manchester Railway Company, respectively, have been consolidated, and the two companies are now under one management with a consolidated capital stock of $300,000. Alf. Rutherford, of Baltimore, Md., has been chosen president.

After a New Line.—It is stated in Montgomery, Ala., that the Western Union Telegraph Company is desirous of obtaining possession of the new Savannah, Americus and Montgomery telegraph line, and has made the company a proposition for its purchase, which offer the company is said to have under consideration The construction of the line is progressing rapidly and it will probably be put into Montgomery by next June.

Hinton, W. Va.—The city council has contracted with the Hinton Electric Light Company for furnishing street lights. The company has been incorporated with a capital stock of $25,000. The incorporators are Messrs. L. M. Dunn, F. R. Von Antwerp, R. R. Flannigan, D. Prince and W. C. Burns. The new company has already placed its order with the Brush people for 100 arc lights and 1,000 incandescent lights, together with dynamos and other requisite machinery.

Electric Elevator Works.—It is reported at Austin, Tex., that Henry W. Morton, of Boston, Mass., and Texas parties have purchased from the Thomson-Houston Electric Company, of Boston, the sole privilege of manufacturing and selling that company's patent electric elevators in the States of Texas, Arkansas and New Mexico. A manufacturing plant is to be established in Austin, if the business men of that city will agree to take one-tenth of the stock in a $100,000 stock company now being organized.

Nashville, Tenn.—The Nashville Telephone Company has declared a quarterly dividend of one and one-half per cent. This is one-fourth less than the last quarterly dividend because of the expense incurred by the company in putting up extra wires all over the city. The return wire system is now in full operation and has proved entirely satisfactory, ending the trouble that has heretofore existed between this company and the United Electric Company. The stock of the telephone company has advanced to 50½ and 51.

The Manufacture of Telegraph Insulator Pins out of locust wood is an industry that has grown to important proportions in western North Carolina during the past six months. There are several factories in successful operation at Waynesville, Hendersonville, and other points. The factory of Arthur & Lipscomb, at Buyson City, has been recently enlarged, and its capacity is now double that of formerly. A new firm, E. G. Coffin & Co., has been formed in the same town to manufacture these pins. Janetts, Keener & Co. are preparing to embark in this business.

Florence, S. C.—The city council has closed a contract with the new electric light company for lighting the streets, and the lights are to be in operation by Dec. 1. The electric light buildings are now being erected. The name of the corporation owning and perating the plant is the Florence Improvement and Manufacturing Company. The officers are Jerome P. Chase, president; G. G. Lynch, vice-president; W. J. Broun, treasurer; C. L. Stickney, secretary and general manager; W. A. Brunson, attorney; L. U. Cox, electrician. In connection with the light plant the company will operate an ice factory.

Roanoke, Va.—The Roanoke Development Company, recently organized to bring a new suburb into the real estate market, intends establishing an electric plant for electric lights and electric street railway. Arthur C. Denniston, of Philadelphia, is president of the company; S. W. Jamison, vice-president and treasurer; W. S. McClannahan, secretary. The directors are P. L. Terry, Roanoke; A. C. Denniston, Richard S. Brock, Clarence M. Clark, of Philadelphia; Joseph H. Sands, James S. Simmons, S. W. Jamison and James A. Gale, of Roanoke Va.

Raleigh, N. C.—The Supreme Court of North Carolina has just filed an opinion in a $10,000 damage suit, brought by J. T. Young, of Craven County, against the Western Union Telegraph Company. Last year Young's wife was taken ill at Greenville, N. C., and telegraphed her husband to come to her. He did not get the message until six days later, and in the meantime Mrs. Young had died and was buried. Young did not learn of his misfortune until several days later. He brought suit in the Superior Court and won his case, but the Western Union took the matter to the Supreme Court, which sustained the finding of the lower court.

Dallas, Tex.—The joint double track of the Dallas Rapid Transit and the Consolidated Electric railways is finished, and is now ready for travel. The Dallas Electric Company have just completed an electrical plant in a fine new stone building. There are two 700 h. p. Hamilton-Corliss engines, with two batteries, of four boilers each. There are five incandescent dynamos, with a capacity of 500 lights. This company has entered into an agreement with all the street car companies, telephone companies and electric light companies in the city to use a union system of poles, which Mr. J. P. Smith, the president of the company, claims will result in a saving of 60 per cent. to all the companies in the combine.

Atlanta, Ga.—The Atlanta Electric Illuminating and Power Company, recently reported incorporated, has perfected a complete organization by the election of the following officers: M. H. Atkinson, president; H. T. Inman, vice-president; George R. DeSaussure, secretary; Walter H. Rhett, general counsel. The directors are H. T. Inman, John Ryan, T. L. Langston, A. E. Thornton, J. W. Rucker, Peter G. Grant, W. H. Inman, A. V. Gude, J. L. Hopkins, M. H. Atkinson and Walter H. Rhett. One hundred thousand dollars is the amount of the capital stock, with the privilege of increasing it any time. It is the purpose of the company to proceed at once to the erection of an extensive electric plant. Power will be furnished for the running of all kinds of machinery, including street railways A considerable portion of the capital to be invested is furnished by Northern capitalists. The illuminating system to be used will be accompanied by the use of electric meters, charging only for actual consumption, and will be something new in Atlanta.

Atlanta, Ga.—The formal organization of the Westerland Electric Conduit Company was perfected a few days ago, and the following officers were elected: President, J. M. Stephens; vice-president, Aleck Beck; secretary and treasurer, J. W. James; attorneys, Dorsey & Howell; board of directors, J. M. Stephens, Aleck Beck, T. J. James. T. L. Langston, Burton Smith, Albert Howell, Jr., H. I. Zachry, J. W. James, W. H. Patterson and W. T. Gentry. This company's capital stock is $600,000. It was decided that only $100,000 of this be placed on the market, the balance being taken by the present stockholders. With the proceeds of the sale of this stock a large foundry will be erected in Atlanta. The company is already in receipt of enough orders to keep the works busy for months and the outlook for the new enterprise is thought to be very flattering. An interesting phase of the work to be immediately undertaken by this company is the application of its electric conduit to elevated railroads. The plans of the company, which were prepared for elevated roads in New York and Philadelphia, contemplate a two-story arrangement, with cars above and below, receiving the motive power from the same wire. It is stated that a railroad company is to be organized at once in Atlanta to use the Westerland conduit.

Richmond, Va.—A recent meeting of the city council called forth the attendance of quite a number of gentlemen identified with electrical interests. Among those present were: J. B. Tree, of the Western Union Telegraph Company; Superintendent McCluer, of the Bell Telephone Company: Superintendent Traylor, of the Traylor Electric Company, and ex-Judge A. L. Holladay, counsel for the two first mentioned companies. The unusual cause which secured their attendance was the question of the Traylor Power Company running its wires on the poles now used by the Western Union Telegraph and the Bell Telephone companies. The Traylor Company has already obtained permission from the council to run its wires through the streets of the city. The city engineer instructed them to use the telegraph and telephone poles. These companies objected to this, and it was attempted to settle the matter by conference, but it could not be done. The city attorney submitted an opinion on the matter, and stated that as the ordinances now stand the telephone and telegraph companies could not be made to allow other wires on their poles. A definite understanding failed to be reached in the matter, and further action was postponed until the return to the city of Major Stiles, the senior counsel of the telegraph company.

Y. N. B.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, Oct. 15, 1890.

Electric Tanning.—While the Worms & Bale process of tanning by electricity has made considerable progress in this country that due to Mr. Grotle is still in the experimental stage. I hear, however, that Mr. Grotle's process will shortly be tested by two experts, whose report may perhaps enlighten us as to the superiority of hanging hides on a frame revolving in a vat of tanning liquor over placing them in a rotating drum filled with the same solution.

Birmingham.—The driver of an accumulator car running on the Bristol road section of the Birmingham tramway system nearly caused a repetition of the recent catastrophe on the Florence Flesole line. For some reason or another he lost control of the car as it was descending an incline, but fortunately brought it to a standstill before it either ran off at a curve or into a car coming in the opposite direction. With the powerful braking action afforded by the reversal of the motor such mishaps should not occur so frequently as they do.

The Electrostatic Phenomena on the Ferranti Cables.—As I informed you in a recent letter the latest trouble of the London Electric Supply corporation's engineers is a peculiar phenomenon, due doubtless to electrostatic causes, which results in the E. M. F. impressed on the secondaries of transformers, the primaries of which are connected to the Ferranti mains running from Deptford, being some 50 per cent. higher than was anticipated. The theoretical investigation of this puzzling phenomenon has been placed in the hands of an able expert who may be expected to give the matter a good mathematical as well as practical solution.

Leamington.—The town of Leamington, the main streets of which have for the last two years been lighted by 16 c.p. incandescents, and the municipality of which has never ceased to make complaints as to the light, determined some few months ago to have the candle power of the street lamps tested. At the last meeting of the Town Council, the committee which was charged with this matter reported that they had found that the lights varied from 12 to 14 c. p., but in no case came up to the guaranteed amount. The Town Council are now meditating a lawsuit against the electric light company for the purpose of recovering the money paid for light which was not supplied. The whole history of this little undertaking should be a warning not to light streets with low candle-power incandescents.

Cable Extensions.—Cable men are constantly bewailing the early exciting days of submarine telegraphy where the laying of a cable at the bottom of the sea was more or less of a leap in the dark, and when the successful completion of the operation meant dinners and other festivities. The excitement of cable-laying is probably in a large measure a thing of the past, but the work of extending the network of submarine cables still steadily goes on. Scarcely a month passes without a cable steamer leaving the Thames for the purpose either of laying an entirely new cable or duplicating an old line. Last week the India Rubber, Gutta Percha and Telegraph Works Company's fine steamer "Silvertown" left London with 2,000 miles of cable on board for the Central & South American Telegraph Company's new line from Lima to Iquique and Valparaiso. Preliminary soundings have shown that depths of over 4,000 fathoms exist on the route originally proposed for the cable, and it is intended to take more careful soundings with a view of seeing whether such dangerous valleys cannot be avoided.

Primary Battery Applications.—The primary battery mania, which seems to be reviving on your side of the water, is doing the same in this country. Mr. J. V. Sherrin has perhaps the most practical application in this direction. He has succeeded in evolving a fairly high and constant E. M. F. two-fluid zinc-carbon cell, and has applied it with a tolerable measure of success to the propulsion of bath chairs, tricycles and small pleasure boats. The consumption of zinc is but very little in excess of the theoretical amount and the E. M. F. is maintained at about 1.7 volts during nine hours with a current of nearly eight ampères, the cell being about 9 by 4 by 4 inches in size. Mr. Sherrin has brought out a bath chair weighing about 200 pounds, propelled by a small motor weighing about 38 pounds and supplied with a current from 18 primary cells, weighing 80 pounds. These 18 cells contain 1½ gallons of depolarizing solution, costing 6d. per gallon, and with this charge the battery can propel the chair on ordinary roads for nine hours, at the rate of six miles per hour. The total cost of running may be figured out at from 3d. to 4d. per hour. The vehicle is easily steered and stopped and can surmount tolerably steep and muddy gradients without much difficulty. In fact, it is a really practical application of the primary battery.

The "Silvertown" Dynamo.—The India Rubber, Gutta Percha and Telegraph Works Company, of Silvertown, who have until lately confined themselves to submarine cable manufacture and telegraph work, are now turning out some remarkably well-finished dynamos, intended chiefly for ship lighting. At the recent Exhibition at Edinburgh this company showed a fine 36-unit machine coupled to a Globe compound engine running at 300 revolutions. The magnets, which are very massive, are of the single horseshoe type, with pole pieces at the lower end. The armature core is built up in the usual way, of thin annealed charcoal iron discs. The manner in which the discs are insulated from one another, is however, somewhat novel. Every alternate disc has a thin coating of special ebonite cured on to a thickness of three mils, the discs themselves being 32 mils thick. This gives over 90 per cent. of iron, or, allowing for irregularities in the plates, 88 per cent. may be reckoned upon in practice. The gun-metal rings which carry the commutator segments are also insulated by the use of ebonite, which is cured on to a thickness of about an eighth of an inch. As these machines have been designed for continuous running in hot engine rooms the temperature rise has been kept very low. Tests made by placing a thermometer on the armature directly the machine stops, and noting the highest temperature recorded, show that the rise rarely exceeds 25 degrees F.

News of the Week.

THE TELEGRAPH.

To Make Printing Telegraph Machines.—The American Type Telegraph Company, with a capital of $600,000, has filed articles of incorporation with the State Department at Trenton, N. J. The company intends to manufacture type and printing telegraph machines.

Nashville, Tenn.—The Postal Telegraph and Cable Company has rented an office at No. 327 Union street, and will open for business about Nov. 1. A branch office will also be established on Market street. The company will have the call-bell service, and will furnish their patrons with every facility offered in larger cities.

Officers Elected.—At the annual meeting of the North Franklin Telegraph and Telephone Company, held at Stratton, Me., these officers were elected: President, Dr. A. G. Howard; secretary and treasurer, Charles P. Bryant, Kingfield; directors, Dr. A. G. Howard, M. B. Pottle, O. W. Tutts, Kingfield; O. A. Hutchins, Stratton; Winfield Emery, Eustis.

Telephone Poles on State Land.—The Postal Telegraph Company has succeeded in running a line of poles for its new line from New York to Buffalo through Rochester in spite of the objections of the city authorities. The poles are placed along the bank of the Erie Canal, on the State property, and it is presumed that the company has obtained the permission of the State authorities.

Injunction against the Western Union.—On the application of the Board of Trade firm of S. W. Lamson & Co., Judge Shepard last week issued an injunction against the Western Union Telegraph Company and the commission firm of R. W. Dunham & Co., restraining them from in any way interfering with the complainant's rights in a leased wire from Chicago to Louisville and Nashville.

Increased Telegraph Facilities.—The New Jersey Postal Telegraph Company, which is connected with the Postal Telegraph Company, of New York, and the Mackay-Bennett Cable Company, began business last week in Orange, N. J., where an office will be kept open in future night and day. It is the intention of the company to extend its lines throughout New Jersey. At present they run only as far as Plainfield.

Extending South American Cables.—The steamer Silvertown, belonging to the India Rubber, Gutta Percha and Telegraph Works Company, Limited, of London, having on board 1,750 miles of cable for the Central and South American Telegraph Company, of New York, passed Dover at 5 P. M. on Oct. 11, bound for Valparaiso. This cable is to be laid between Chorrillos, Peru, and Valparaiso, Chili, touching at Iquique, as an extension of the American line via Galveston.

A New Cable Enterprise.—It was reported by cable from London last week that an undertaking had been proposed to lay a new cable across the Atlantic from Valencia Bay, on the west coast of Ireland, to a point near this city if possible. The scheme was said to involve a capital of £800,000 to be taken by eight men at £100,000 each. It was thought that the real object of the enterprise was to reduce the cable rates to three pence a word. Russell Sage, when questioned concerning the enterprise, was inclined to be ex-

tremely sceptical of the truth of the story. "People are constantly getting up schemes like this," he said, "but it is seldom they amount to anything. If it is true that the promoters of this one intend to reduce the cable rates to three pence a word, or about one-fourth of the Western Union rates, they might examine with profit the last annual report of the Western Union Company, which was prepared with the greatest care, and I doubt if they would then be so certain of realizing the big dividends they are said to expect. I don't believe they could make a cent on the basis proposed."

THE TELEPHONE.

The Mexican Telephone Directors have, it is said, agreed upon an adjustment of the suit brought against them by their old manager, John Crawford. The suit was brought for $4,000, but the settlement was effected at $1,250. Several of the patent suits have also been compromised on a very satisfactory basis.

Gain of Subscribers.—For the quarter ended Sept. 30 the Erie Telephone Company made a net gain of 277 subscribers, as follows: Cleveland division, 29; Minnesota and Dakota divisions, 31; Arkansas division, 73; Texas division, 141, a total of 277. The total gain for the first six months of the fiscal year was 694 and the total number connected Oct. 1 was 12,939.

Dividend and Quarterly Statement.—The directors of the New England Telephone and Telegraph Company have declared the usual quarterly dividend of 75 cents per share, payable Nov. 15 to stockholders of record Oct. 31. The transfer books will be closed from Nov. 1 to 14, both days included. The quarterly statement makes the following comparisons:

QUARTER ENDED SEPT. 30.

	1890.	1889.	
Gross receipts	$361,339	$326,181	Inc., $35,158
Expenses	261,482	225,790	Inc., 35,692
Net receipts	$99,857	$100,391	Dec., $534
Construction	68,063	56,960	Inc., 11,103
Balance	$31,794	$43,451	Dec., $11,367

JAN. 1 TO SEPT. 30.

	1890.	1889.	
Gross receipts	$1,042,788	$959,393	Inc., $92,395
Expenses	767,281	681,175	Inc., 86,106
Net receipts	$275,507	$269,218	Inc., $6,289
Construction	129,114	94,647	Inc., 34,467
Balance	$146,393	$174,571	Dec., $28,178

The American Bell Telephone Company makes the following statement for the month ended Oct. 20:

October—	1890.	1889.		
Gross output	5,378	5,152	Inc.	226
Returned	2,205	1,781	Inc.	424
Net output	3,173	3,371	Dec.	198
Dec. 21 to Oct. 21—				
Gross output	53,787	48,394	Inc.	5,393
Returned	2,315	19,898	Inc.	2,417
Net output	51,472	28,496	Inc.	2,976

The following is a summary of the telephones now under rental by the Bell Company:

Dec. 20, 1889, there were in licensees' hands under rental, as per last report		444,861
In the month ended Jan. 20 there were added	1,101	
" " " Feb. 20	2,037	
" " " March 20	3,531	
" " " April 20	4,170	
" " " May 20	4,803	
" " " June 20	5,831	
" " " July 20	1,960	
" " " Aug. 20	1,561	
" " " Sept. 20	2,365	
" " " Oct. 20	3,173	
Increase in telephones under rental, ten months		31,472
Making the total number Oct. 20, 1890		476,333
Comparing the same time 1889 with		439,036
Increase in telephones under rental		37,297

THE ELECTRIC LIGHT.

Dividend.—The Edison Electric Illuminating Company, of Fall River, Mass., has declared a quarterly dividend of 1½ per cent.

New Rochelle, N. Y.—For lighting the village streets the trustees have recommended the payment of $125 per year for each arc light, $25 each for 100 incandescent lights, and $25 each for 100 gas lights.

St. Louis, Mo.—An ordinance has been introduced in the City Council to extend the city's street lighting contract with the Citizens' Electric Light Company from three to ten years on the condition that all lamps should be burned every night in the year from dusk to daybreak without extra charge.

Bristol, R. I.—The Bristol Electric Light Company is making arrangements to enlarge its plant by adding a new engine of 130 h. p., and a new dynamo which will run 1,300 incandescent lights of 16 c. p. each. With its present capacity the company will have engines of 220 h. p. and 2,000 incandescent lights, beside the dynamo which runs the arc lights.

Lynn, Mass.—The fly wheel of one of the large Corliss engines in the central station of the Lynn Gas and Electric Company flew to pieces last Sunday afternoon, damaging the building to a considerable extent. No one sustained personal injury. The accident was due, it is said, to a sudden increase of speed, caused by the failure of the engine governor.

Electric Light and Breweries.—The breweries at Pittsburgh have always been lighted by gas, but the other day Hipeley & Sons placed with the Edison people an order for a 100-light plant to be used in their brewing establishment. The breweries of the city, if they see fit to adopt the move of Hipeley & Son, will not only secure a better illumination than now but have the additional advantage of a lower insurance rate.

The Chartiers Valley Light and Power Company, of Chartiers, Allegheny County, Pa., has been organized. The capital of the concern is $30,000. The directors are Messrs. S. A. Duncan, Pittsburgh; William J. Langfitt, Allegheny; William M. Galbraith, Chartiers; E. G. D. Hender, Mansfield; J. A. Langfitt, Wilkinsburg Besides erecting a lighting plant at Chartiers, the company intends to build a street railway line from Mansfield to Pittsburgh. The distance between the two places is ten miles.

Elmira, N. Y.—Among the contracts for alternate current electric lighting apparatus which the Westinghouse Electric and Manufacturing Company obtained during the last week is one from the Elmira Illuminating Company, of Elmira, N. Y. This company was organized only a little over a year ago with a view of supplying the citizens of Elmira with light. The plant erected was furnished with an apparatus of 750 lights capacity. The demand for the modern system of illumination, however, increased to such an extent that the Elmira company was obliged to arrange for several additional alternating current machines. Three times an increase had to be made to the capacity, until to-day the central station has generating machinery for a capacity of 3,750 alternating current incandescent lamps, the last contract being for 1,500 lights.

Tampa, Fla.—Electric lights have been in operation in Tampa, Fla., since 1887, and since then the Florida Electric Company of that city has energetically gone to work to prove to its patrons the many advantages accruing from the use of electric illumination. Operating the Westinghouse alternate current system of incandescent lighting, their task was of course an easy one, and it is gratifying to know that a few days ago the company contracted for additional apparatus which will enable the Tampa central station plant to generate sufficient electricity for furnishing the city with 1,900 incandescent lamps.

The Hartford Electric Light Company is at present working its station to its full capacity. The station is located just back on State street, near Main, and its size is 65×90 feet. The power consists of two Russell engines, 125 h. p.; one Ide, 125 h. p.; three Armington & Sims, one 50 h. p., one 45 h. p. and one 95 h. p.; two New York Safety Company's engines, one 60 and one 125 h. p. The boiler room is 75×35, and contains five 200 h. p. Cunningham boilers. Four Thomson-Houston incandescent machines, 400 lights each, two Thomson-Houston alternaters, 650 each, and six Ball 50-light machines generate the current. The company has in use at the present time 4,600 incandescents and 800 arcs.

Westinghouse Sales.—The Westinghouse Electric and Manufacturing Company received during the week preceding Oct. 22 contracts for the installation of alternating current incandescent light plants at the following places: Manchester, N. H., 1,500 lights; Cohoes, N. Y., 750 lights; Amesbury, Mass., 500 lights; Aransas Pass, Tex., 750 lights; New Cumberland, W. Va., 750 lights; Rich Hill, Mo., 750 lights. In addition to this, the alternating current central station plant at Havana, Cuba, is again compelled to increase its capacity. The Havanese intend to furnish all the suburbs of the city with electrical illumination. They purpose to extend the plant for eight miles around the city and to this effect the Westinghouse Electric and Manufacturing Company has contracted to furnish a 2,000 volt 750-light plant. The Westinghouse alternating current arc light system is now being introduced in Norwich, N. Y.

Recent Sales.—The Western Isolated Lighting Department of the Thomson-Houston Electric Company has recently made the following sales: W. C. Ritchie & Co, paper box manufacturers, 153 Michigan avenue, Chicago, 200 incandescents; John Kranz, confectioner, 80 State street, Chicago, 300 incandescents; Calumet Distilling Company (increase), New Chicago, Ill., 25 incandescents; Baker & Vauter, printers, Chicago, 100 incandescents and electric plating machine; Elite Furniture & Lumber Company, Argenta, Ark., 30 arcs; Academy of Music, Chicago, 18 arcs; National Forge & Iron Company, East Chicago, Ind., 20 arcs; A. H. Andrews & Co., office furniture, Chicago, 600 incandescents; Consolidated Piedmont Cable Company, Oakland, Cal., 30 arcs; Citizens' Street Railway Company, Indianapolis, Ind., 30 arcs; Dernberg, Glick & Horner, dry goods, Chicago, 45 arcs; Mountain Ice and Cold Storage Company, Salt Lake City, Utah, 50 incandescents; Illinois Steel Company, South Chicago, Ill., 30 arcs; D. D. Wilder, Santa Cruz, Cal., 100 incandescents; Ira C. Darling & Co., Stock Yards, Chicago, 150 incandescents; Shailer & Schiglau, for Lake View tunnel crib and water-works, 75 incandescents, and one 1 h. p. motor; Crocker Chair Company, Sheboygan, Wis., 500 incandescents; Wright & Hills Linseed Oil Company, Chicago, 150 incandescents; Goetz & Brada Manufacturing Company, 12 arcs; C. T. Roenitz Leather Company, Sheboygan, Wis., 150 incandescents; Huntington, Hopkins & Co., office building, San Francisco, Cal., 200 incandescents; Hanson Furniture Company, Janesville, Wis., 75 incandescents; City of Chicago, Hyde Park and Lake water-works (increase), 30 incandescents; H. A. Foster & Co., Pontiac, Ill., 100 incandescents.

APPLICATIONS OF POWER.

Braddock, Pa., is to have another electric street railway which is designed to connect Braddock with Wilkinsburg, three miles distant. The Borough Council has granted the right of way. Work is to commence within sixty days, and be completed within one year. The incorporators of the company are A. L. Sailor, C. F. Ellis, C. C. Lee, J. C. McKelvy and H. C. Newmyer. There is said to be business enough to justify the building of the line.

Street Railway Progress in Pittsburgh.—The power house of the Birmingham Traction Company is being pushed to completion with the utmost rapidity. There is no official information on the subject, but appearances would indicate an intention to use the Short system of electrical propulsion. The Pittsburgh and Allegheny Traction Company is just as busily at work on its track laying and power house, and the horses and mules will soon be withdrawn from two of the largest street railway systems in Pittsburgh and Allegheny.

Sale of an Electric Road.—The Squirrel Hill Electric Railroad, so many obstacles to the completion of which have made their appearance, was sold a few days ago to New York parties. Twenty-five thousand dollars was the price received. The debts of the company are about $40,000. The line if completed will tap a good part of the city as yet unprovided with rapid transit facilities. Schenley Park is reached by it. It is pretty generally the opinion that the parties from New York who did the buying were acting for the Pittsburgh Traction Company, which is supposed to be anxious to get hold of the Squirrel Hill road to use as a feeder.

The Duquesne Traction Company, of Pittsburgh, promises to have running not later than Dec. 1, 1890, its electric cars between the heart of Pittsburgh and the East End suburbs of the city. Within a couple of weeks the 45 cars to be used on the line will be received from the Pullman Company. The power station, which is situated midway between Pittsburgh and East Liberty, is practically completed, as the foundations for the engines are ready, all that is necessary being to set the engines on their beds and connect them with the dynamos. The boiler house is ready for work. This power station is a very large and complete affair, constructed of brick. Coal will be used for fuel.

The Rae System in Texas.—The Galveston (Texas) City Railway Company has contracted with the Detroit Electrical Works for a full electrical equipment of Rae motors and generators. The first installment of 20 motor cars and four generators with full station equipment will be in operation on or before January 1, 1891. Col. Sinclair, President of the Galveston Railway system, made very careful investigations of the various systems, and his ultimate decision is a very high compliment to the Rae system. The Detroit Electrical Works have forwarded to Portland, Ore., the first shipment of their standard 30 h. p. motors and trucks (Rae system) as the forerunner of a large order.

Atlanta, Ga.—A practical test of the Westerland electric underground conduit was recently made with very satisfactory results. The operation was made publicly at the plant of the Fulton County Electric Street Railway Company. A track laid especially for the experiment had been arranged with the newly-invented appliances, and measured something over a hundred yards on a steep grade. One of the cars belonging to the Fulton County electric line was fitted with such fixtures as were necessary to adapt it to the underground system. The conduit was imbedded in the ground midway between the two tracks. A company to operate the new conduit has been chartered under the name of "The Westerland Electric Conduit Company." It is composed of the following owners of the invention: N. J. Zachry, T. J. James, Alexander Beck, R. T. Dorsey, Albert Howell, Jr., and Mrs. Lawrence Westerland. The charter permits the company to organize with a capital stock of $200,000, with privilege to increase same to $1,000,000. The company propose building a foundry in Atlanta, for manufacturing the castings, and will equip railroads in different parts of the country.

PERSONAL.

Mr. Frederick B. Rouquette, who is connected with the Edison General Electric Company, of this city, returned last Sunday on the "Arizona" from Europe, where he has been spending a short vacation.

MISCELLANEOUS NOTES.

The Edison Doll Company's Annual Meeting was adjourned to Oct. 30 for lack of a quorum of proxies. The shareholders of this company number 620, against 560 a year ago. These stockholders hold 84,000 shares.

The Pittsburgh Exposition.—From the account of the electrical display at the Pittsburgh Exposition recently published in THE ELECTRICAL WORLD, reference to the attractive exhibit of the Union Electric Company was, by an oversight, omitted. That company, which is the Pittsburgh agent for the Perkins lamp, Simplex wire and other articles belonging to the electrical trade, is well represented in the main hall of the Exposition by a fine collection of bells, batteries, wires and so forth. The Westinghouse exhibit has been pleasingly increased by the addition of one of the noiseless street car motors of the company's manufacture, which really goes about its work in an entirely silent manner. Naturally, a great deal of attention is bestowed upon this outfit by the visitors. The Thomson-Houston representatives, Messrs. Hughes & Gawthrop, have gotten an electric welding machine to work, and much interest is manifested in this machine by the crowds of people that daily throng the Machinery Hall.

A District Call System.—Quite a novel application of electricity is reported from an enterprising town in Texas, it being practically a system of district calls, in answer to which a supply of beer is sent to any of the call stations. It so happens that a wideawake merchant controls all the saloons in the place, as well as some ice houses, and in order to save the expense of keeping a stock at each saloon, he has hit upon the call system as the simplest and best medium. He accordingly carries but a small supply at each of the refreshment places, and keeps the bulk of beer and ice at one central point, from which a fresh lot can be promptly sent to any of the saloons on receipt of a call from that point. The cost of installing the system is so low that it is expected to pay for itself very quickly by the saving effected in ice, to say nothing of the valuable additional convenience of such a service. The Great Western Supply Company has furnished the apparatus and supplies, and is confident that similar systems will be installed for use with other lines of merchandise, especially in the Southern and Western towns.

New Electrical Books.—According to the announcements given in the last number of *Nature*, the London publishers have under way quite a number of new and valuable books upon electrical subjects. Messrs. MacMillan & Co. will publish "Electricity and Magnetism," an illustrated popular treatise, by Amédée Guillemin, translated and edited with additions and notes by Prof. S. P. Thompson; "Popular Lectures and Treatises," by Sir Wm. Thomson, Vol. III. "A Treatise on Electricity and Magnetism," by J. Clerk Maxwell, new edition, and "An Introduction to the Mathematics of Electricity," by W. T. A. Emtage. The Pitt press announces "Mathematical and Physical Papers," by Sir Wm. Thomson, Vol. III., and the Methuen Science Series, edited by Mr. R. Elliott Steele, will include among other volumes one on "Elementary Electricity and Magnetism." Messrs. Charles Griffin & Co. will issue a "Text Book of Electro-Metallurgy," by W. G. MacMillan and a complete volume of Prof. Jamieson's "Elementary Manual of Magnetism and Electricity." Messrs. Whittaker will publish a new and revised edition of Mr. Gisbert Kapp's "Transmission of Energy" and of Mr. S. R. Bottone's "Electro-Motors."

Quotations on Electrical Stocks.—Mr. F. Z. Maguire, electrical securities, of 18 Wall street, this city, reports the following quotations of Saturday, Oct. 25, from New York, Boston, Washington and Pittsburgh:

NEW YORK.

	Bid.		Bid.
W. U. Tel. Co.	81	Edison Gen. Elec. Co.	95
American Tele. & Cable	83	Edison Gen. Co. Def'd	88
Cent'l & So. Amer.	155	Consol'd Elec. Lt. Co.	
Mexican	208	Edison Illn'g Co., N. Y.	68
Com. Cable Co.	100	U. S. Elec. Lt. Co.	30
Postal Tel. Cable	39	North Am. Phon'gph.	

BOSTON.

	Bid.		Bid.
Thomson-Houston	51⅛	Ft. Wayne Co.	121½
" Pref'd	26½	Am. Bell	226
" Series C.	11½	Erie	50
" " D.	6⅛	New England	52
" Int. Co.		Mexican	.75
Thomson Welding Co.	185	Trop. American	
Thomson Eu. Welding	60	Edison Phon'gph Doll	2

WASHINGTON.

	Bid.		Bid.
Penna. Telephone	25	Eck. & Sold. Home Elec. Ry.	65½
Ches. & Pot. Telephone	68*	Amer. Graphophone	49
U. S. Electric Lt. (Wash.)	14⅛	Georget'wn & Tenallyt'n.	
	150		

PITTSBURGH.

	Bid.
Westinghouse Electric Manufacturing Company	29

* Ex. dividend.

Industrial and Trade Notes.

The Car Metal Company, of Fall River, has doubled its business in the last month. Recent tests have proven that its zincs are of very high standard, and the outlook for the future is very promising.

Medical Batteries are manufactured by the Jerome Kidder Manufacturing Company, of this city, which are meeting with great success and are having a very wide sale. Some excellent recommendations have been received from users of these batteries which speak in very high terms of their value.

The H. A. Williams Machine Company, of Boston, has just issued a new price list. In it is included the new oiler with non-magnetic nozzles, for use by the electrical trade. This company's specialties are attracting much attention and favorable mention from all who have used them.

The American Steam Packing Company, of Boston, has just put before the trade a new engine packing called the "Electric." This packing has been especially prepared for the electrical trade after careful and expensive experiments, and is pronounced by prominent engineers to be an excellent piston packing.

The Fletcher & Fletcher Electric Company, of Cleveland, O., is doing a prosperous business in the sale of general electrical supplies, and is furnishing to the public a great variety of excellent batteries, spark coils, push buttons, etc. The "Medico-Electric Jar" is meeting with considerable success in its particular field.

The Electric Merchandise Company, of Chicago, has issued a supplementary catalogue of material which it keeps in stock for electric railroads using the Sprague system. This catalogue is illustrated with cuts of the various parts of both the old and new Sprague motors, and contains prices of all the interchangeable parts.

The American Oil Company, of Providence, R. I., is manufacturing a new dynamo oil especially to meet the requirements of very high speed machinery. It is guaranteed to be entirely free from carbonizing properties, and a superior oil in every respect. Excellent testimonials have been received by them from a number of electric light companies.

The Consolidated Fruit Jar Company, of New Brunswick, N. J., which has recently taken up the manufacture of quite a variety of electrical novelties, has issued a "sheet metal card," which is very artistically decorated and finished, as a specimen of the company's work in the manufacture of decorated metal boxes and metal novelties of various kinds.

William Ryle & Son, 54 Howard street, this city, are making a specialty of furnishing silks for electrical purposes, and have been in the business since April, 1879. They claim special advantages for their silks used for insulating very fine wire, and these silks are furnished on spools of all kinds to fit the various wire-covering machines, and any color desired may be obtained.

The Great Western Electric Supply Company reports continued activity in all departments. Its orders for rail bonds, pole ratchets and curve insulators are in keeping with the growth of the electric railway, and the new designs of fixtures are meeting with ready sale. The company is also supplying the coming generation with learners' telegraph instruments and with a variety of experimental apparatus.

The Union Glass Company, of Boston, with factories at Somerville, is making what is termed and indeed is recognized by the trade as a perfect arc globe. Large orders have recently been received from electric light companies, and the company is rushed with business. In addition to the above it is turning out some very unique designs in incandescent shades. This company also manufacture large quantities of bulbs for incandescent lamps.

The New York Insulated Wire Company, from the number of orders it has received from the United States Government for large quantities of its Grimshaw wires, has begun to feel entitled to the name of "National Wire Manufacturers." This company has furnished the wire for the Statue of Liberty in New York harbor, the Washington Monument at Washington, and the buildings of the State, War and Navy departments at the United States capital.

Some Very Small Castings have recently been turned out from the large foundry of the Consolidated Fruit Jar Company, New Brunswick, N. J., from the same blast with some very heavy castings. A few days ago, castings weighing three ounces each and a casting weighing 3,300 pounds were turned out from the same blast. One of this company's specialties is the making of small brass castings for electrical purpose—such as switches, sockets, cut-outs, etc.

The International Aluminum Works, 36 and 38 John street, this city, and 86 New street, Birmingham, England, are the manufacturers, under H. Gilbert Coyle's processes, of aluminum electroplating solutions and anodes, and are prepared to furnish these in any quantity and guarantee them to be "practical." The manufacturing is under the personal supervision of Mr. Coyle, whose practical experience covers a period of 25 years as an electro-metallurgist.

The Lockwood Instrument Company, Detroit, was very pleasantly referred to a few days since by the manager of one of the great central lighting stations, who said that there was a finished appearance about the work sent out by that company that was most gratifying, and that experience had taught him that when small instruments or devices were needed, the Lockwood Company could generally manufacture just what was desired at short notice, and at reasonable prices.

The Hall Signal Company, 50 Broadway, this city, is installing its system on two trunk lines which are now equipped with another system of signals, and these will be displaced as soon as the Hall signal is in working order. This company has some very large orders on hand, and is just completing the equipment of 200 miles of road. Estimates are being made on over 1,000 miles of railroad in this and other countries. Besides its regular signal system the company is also installing a large number of bell signals at highway railroad crossings.

Mr. Charles B. Hardick's "Niagara" steam pumps and pumping engines and hydraulic machinery are very minutely described and well illustrated in a new pamphlet which he has just issued. Besides the interesting matter concerning these machines, the catalogue also contains some valuable data in regard to the friction of water in pipes, some steam tables and other matter of considerable importance to steam and hydraulic engineers. The works of this company are located at 118 to 122 Plymouth street, Brooklyn.

The Gibson Gas Fixture Works, of 1,426 Callowhill street, Philadelphia, Pa., receive so many letters asking their assistance in procuring orders for the equipment of buildings that they have issued an announcement which says: "We think that no manufacturer of gas and electric light fixtures should hold communication with a consumer direct, even by the invitation of a dealer." This company is firmly convinced that this is the proper position for the manufacturer of gas and electric light fixtures, and believes that the trade will finally coincide in this view.

The Consolidated Electric Storage Company, 120 Broadway, this city, has recently taken some large orders through its various agencies for Julien batteries. Orders for complete plants, including engines, dynamo and storage batteries, have been secured by the Philadelphia and New York agencies, and the equipment for some isolated plants is now well under way. The circulars of this company, recently issued, contain considerable interesting information concerning the cost of storage battery lighting for isolated plants, and are in great demand.

W. W. Tupper & Co., 206 West street, New York, are placing upon the market a patent sectional grate and grate bars for anthracite and bituminous coal and also for sawdust and shavings. These grates have been extensively used for the past 11 years, during which time they have been furnished to over 8,000 plants. They have proved to be a substantial and economical grate. The descriptive circular which the company issues contains references to present and past users of these appliances, and letters of recommendation which speak very highly of their good qualities.

The Employers' Liability Assurance Company, Ltd., has adopted a new feature in assurance, which has created great interest among property holders. It is called the "General Liability Policy," in presenting which attention is directed to the very large number of claims which are made every year upon owners and lessees of property for compensation on account of personal damages occurring through alleged defects in and about buildings. This corporation not only protects the landlord by assuming his liability for such cases, but at its own cost defends any suits which may be brought.

The Boughen Engineering Company, of Cincinnati, has just completed several large steam plant installations and reports the outlook good for an abundance of work during the entire winter, especially in the electrical field. As is well known, this company has secured the general agency of the following standard houses: Abendroth & Root Manufacturing Company, Murphy Iron Works, Warren, Webster & Co., Goubert Manufacturing Company, Hyatt Pure Water Company, Taylor Manufacturing Company, Hooven, Owens & Rentschler Company, Gordon Steam Pump Company, Irvin Van Wie, Hill Clutch Company and Elastic Metallic Packing Company.

The Simplex Company is constantly in receipt of very excellent testimonials, but none can be more remarkable than the following, received a short time since. Some four years since the Riverside Worsted Mills, at Providence, R. I., was wired for electric lights. A very severe test was given the wires in the dye house, where the room is filled with hot steam more or less impregnated with acid fumes for 10 hours a day, but the simplex (No. 14) proved equal to the test, and lately samples were sent to Boston with a letter of approval. The Fitchburg Railroad Company has ordered 150,000 feet of this wire to be used in the operation of lights in the Hoosac Tunnel.

Tucker Electrical Construction Company, of this city, is installing in the new Arbuckle apartment house, Brooklyn, 1,100 lamps, a complete bell and annunciator outfit, watchman's clocks, etc. The Interior Conduit system for running the wires is used and the equipment requires several hundred thousand feet of Grimshaw white core wire. This company lately started up and is now running the electric light plant at the American Institute Fair of this city, consisting of 100 lamps of the Schuyler system of 2,000 c. p. each and 800 16-c. p. lamps of the Mather system, using the Perkins lamp. This company is also wiring the factory of the Otis Brothers, at Yonkers, N. Y., for 20 arc lights and has in process of construction an installation for Halstead & Co., 202 Forsyth street, this city, for 200 Perkins lamps with the Mather dynamo.

The Eureka Tempered Copper Company, North East, Pa., has received a letter from Mr. J. H. McEwen, of Ridgway, Pa., in which he says: "In reply to your inquiry about the working of the large boxes sent us nearly a year ago, will say that the boxes were used for journal boxes for a large crusher, and have been in constant use for nearly a year, crushing about 60 cords of hemlock bark every 10 hours. They are running cool, and show very little wear. Before we commenced the use of tempered copper we used brass and genuine Babbitt, but were bothered greatly by the heating of the journal, owing to the great pressure. With your boxes we have no trouble of this kind. It is the best metal we have ever used for journal boxes working under great pressure."

Lane & Bodley, the well-known Corliss engine makers, of Cincinnati, are building an addition to their already large plant, that will be 358 feet long, 80 feet wide and 34 feet high in the clear, an increase in space made necessary by the rapid growth in their business. At the present time they are crowded with orders from electrical companies and are shipping a 30 × 60 Corliss of 500 h. p. to the Des Moines, Ia., electric railway plant, the fly wheel of which is 24 feet in diameter, with a 52-inch face and weighs 55,000 pounds. They are also building a 22 inch × 42 inch × 48 inch compound condensing engine of 500 h. p. for the local Broadway electric light station, and for the Cincinnati Street Railway Company's electric station they are furnishing everything except the dynamos, including three Corliss engines, one 24 inch × 60 inch and two 28 inch × 60 inch. They are using fly wheels cast in one piece, one of which measures 20 feet in diameter with a 51-inch face. Prior to shipment these great castings are neatly fractured across the centre by striking a set of wedges previously inserted, the fractured edges fitting more closely and tightly than finished edges. All their castings are noted for their smoothness and finished character.

The Page Belting Company, Concord, N. H., is very busy on all classes of goods, both staple and special, which it manufactures. Among the large orders recently filled are the following: A 48-inch heavy double belt, 127 feet long, sent to the Thomson-Houston Company, Memphis, Tenn.; a 32-inch belt, 114½ feet long, sent to the Malloon Manufacturing Company, Sheboygan, Wis.; a 24-inch belt, 135 feet long, sent to the Star Thread Company, Athens, Ga.; a complete outfit for the Chicago, St. Paul, Minneapolis & Omaha Railroad; a lot of 15-inch light dynamo double belts for the Edison Company at Chicago; several electric belts to W. A. Brown, Lynn., Mass., the special Acme link belts to a large number of customers, and among them the following: The Pennsylvania Railroad Company; the White Manufacturing Company, Rockville, Conn.; Marshall Light and Power Company, Marshall, Tex.; H. D. Smith & Co., Fayetteville, Tenn.; Davis & Thomas, Catasauqua, Pa. The company reports these belts in several cases as having been put on dynamos where the draft was at the top fold instead of the under fold of the belt, and in some cases where dynamos are placed tandem. In some cases link belts are in use with light dynamo double belts running over the link belts. The company's works in Concord, N. H., are taxed to their utmost capacity, and the branches at Boston, New York, Chicago and San Francisco are full of business.

The Incandescent Lamp Situation is growing decidedly interesting. The latest lamp is offered to the public by Alexander, Barney & Chapin, of the Telephone Building, 20 Cortlandt street, this city. Surely if any one ought to know what is needed in the way of an incandescent lamp, here are the men, for they have spent several years in the management of a large factory which manufactured several thousand incandescent lamps each day, and they are well acquainted with the wants of consumers and thoroughly understand how to meet these wants. The new lamp of this company is said to be equal at least to anything heretofore known on the market, to give a clear, white light, and to be made for all voltages and of all candle powers and to fit any socket. Another point of interest is that Alexander, Barney & Chapin have arranged for the sale of Edison lamps at Edison prices, as well as other Edison appliances. This arrangement has been made so that it will be possible to supply the large demand which exists for goods of Edison manufacture, so that if a customer wants Edison lamps he can get them, or if he desires the "A B C" lamp he can be supplied with that also. The new supply house has also gone into the book business and announces that it will carry a well stocked library of electrical and scientific works. Thomson-Houston and Edison railway appliances have also been added to the stock and orders for such goods can be filled direct from New York. One of the company's finest exhibits in their new store is that made by Queen's measuring and testing instruments, which the "A B C" firm is now selling at manufacturers' prices. Arrangements have been completed for the exclusive agency of some new switches, cut-outs and other electrical appliances, and on the whole the new firm is doing a very successful business.

Answers to Correspondents.

Best Method of Stopping a Dynamo.—We are running two Indianapolis Jenney 35-light dynamos in series in one circuit. In stopping and starting them we use friction pulleys, belting both machines from the same wheel. Both the machines are used during the first part of the run, and then the load is thrown upon one. What is the best way of cutting out the second machine—to pull the clutch and stop the machine, to shift the brushes and open the circuit at the same time, or to lower the brushes about half way and then throw the switch? F. A. W.

Letting the machine slow down has the same effect on electromotive force as shifting the brushes. Would prefer to pull the friction clutch and change the connections before it comes entirely to rest.

Primary Batteries for Incandescent Lamps.—I wish to construct some batteries to run an incandescent lamp. If I have a lamp that requires 16 volts and 1.2 ampères, and I construct a battery to give that ampèreage and two volts, should I connect eight cells in series; or if the cell produced only six-tenths of an ampère and two volts, should I connect two in multiple and eight in series? J. H. R.

A battery that would give on an ampèremeter only 1.2 ampères with two volts electromotive force would be a very poor kind of cell to employ for running an incandescent lamp. Get all the capacity in ampèreage possible; in other words, make the internal resistance of the batteries as small as you can and then put, if they give two volts each, eight cells in series. In any kind of primary battery work it is desirable to make the internal resistance of the battery as low as possible. A very common mistake is to suppose because the maximum work which can be gotten out of a battery is when the external resistance is equal to the internal such an arrangement is desirable to use. On the contrary, it should only be used when absolutely necessary, since under these circumstances half the energy of the batteries produces no useful effect. For electric lighting then use batteries with large surfaces of zinc and carbon and put enough in series to give the required voltage, as batteries seldom give as high an electromotive force as two volts, and something is to be allowed for fall of potential for the circuit (batteries included) aside from the lamp. To run a 16-volt lamp you would probably find about nine large cells necessary; but these would run several such lamps in multiple.

Ampere Hours Defined.—Will you please tell me what I am to understand by a cell or battery having a capacity of 50 ampère hours, and how am I to find out how long four such batteries, two in parallel and two in series, will sustain 18 half-candle power lamps in multiple arcs? C. C. W.

By a battery having a capacity of 50 ampère hours it is meant that the zincs and solution will enable 50 ampère hours to be drawn from the cell without recharging. In other words, if you draw 10 ampères, provided so large a discharge is possible, the batteries would last five hours. If you draw out two ampères it will last 25 hours, and so on. Your batteries being two in series, you draw ampères from both batteries together. Having two in parallel is equivalent to doubling the capacity of the cell; in other words, 100 ampère hours is the available capacity, for you practically have two cells each of 100 ampère hours. But to feed your lamps at the regular potential, put them in series and draw current from both. Your half-candle power lamps will take a little over an ampère apiece, so that your battery would operate them for about five hours if its internal resistance is low enough to stand that rate of output without excessive waste.

Sulphating of a Storage Cell.—1. What is meant by sulphating in storage cells? 2. If a current is passed in a negative direction through a storage cell, what would be the effect? 3. Does breaking a circuit reverse the current therein; if so, how? STUDENT.

1. Conversion of the active material into lead sulphate by action of sulphuric acid in the cell. 2. The current passed in the wrong direction through a storage battery causes rapid deterioration of the active material and is likely to ruin the battery. 3. There is a self-inductive kick when the circuit is broken, but it is in the same direction as the current itself.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Co., of 105 South Warren street, Syracuse, N. Y.

To All to Whom these Presents May Come, Know Ye.—By a resolution duly passed by the corporation known as "Hazazer & Stanley," it was voted to change the name of said corporation, with permission of the court, from "Hazazer & Stanley" to "Stanley & Hall."

Now, by order of the Supreme Court, it is made known that from this time the name of said corporation is and shall be "Stanley & Hall." A. F. STANLEY, President.

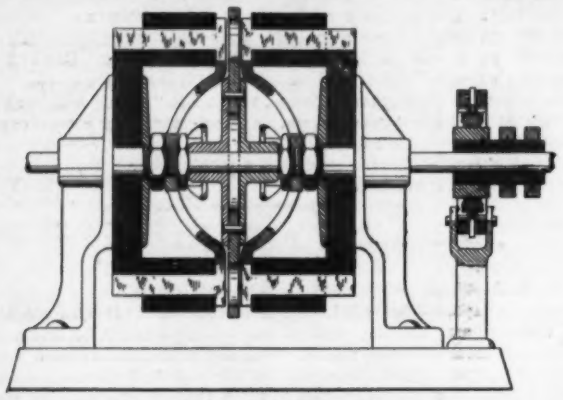
Through Vestibuled and Colonist Sleepers Between Chicago and Tacoma, Wash., and Portland, Ore.—The Wisconsin Central and Northern Pacific lines run through Pullman vestibuled and Colonist sleepers between Chicago and Tacoma Wash., and Portland, Oregon. The train known as the "Pacific Express" leaves the Grand Central Passenger Station, at the corner of Fifth avenue and Harrison street, at 10:45 P. M. daily. For tickets, berths in Pullman or Colonist sleepers, etc., apply to Geo. K. Thompson, City Passenger and Ticket Agent, 205 Clark street, or to F. J. Eddy, Depot Ticket Agent, Grand Central Passenger Station, corner Fifth avenue and Harrison street, Chicago, Ill.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS

U. S. PATENTS ISSUED OCT. 21, 1890.

438,598. Electrical Water Alarm; Francis M. Ashton, of Lima, O. Application filed Jan. 15, 1890. This invention consists in a hollow vessel communicating with the boiler, so that the height of the water in one will correspond with height of water in the other, two floats arranged one above the other within said vessel upon independent rods, the rods to which the lower float is attached passing through the upper float, and suitable levers connected with said float-rods and adapted to make and break an electrical circuit and sound an alarm by the movements of the floats.

438,602. Alternating Current Generator and Motor; Charles S. Bradley, of Yonkers, N. Y. Application filed June 23, 1890. The invention consists in the combination of a multipolar



No. 438,603.—Electric Motor.

machine having on its axis the inducing member of an auxiliary magnetic system in addition to its own armature, cross-connected in a reverse manner so that the shifting polarity which takes place in its rotation is caused to take place in the rotating inducing member of the auxiliary magnetic system in a direction the same as its rotation, thus doubling the speed of polar propagation, and in causing the auxiliary member to produce alternating currents in the stationary secondary circuit.

438,603. Electric Motor; Charles S. Bradley, of Yonkers, N. Y. Application filed Aug. 13, 1890. The invention comprises a single current field magnet, an armature having two or more closed induced circuits and a commutating device for shifting the neutral point in the field magnet and producing progressive torque.

438,619. Arc and Incandescent Lighting System; John Edward Giles, of Hazleton, Pa. Application filed July 12, 1889. In an electric lighting system the combination with a circuit of constant potential of arc lamps in multiple-arc relation, each cross branch of the multiple-arc system containing two or more lamps, a magnetic regulator in each such branch and a resistance controlled thereby, said resistance being a fractional part in amount of the normal resistance of the arc branch, to compensate variations in the current strength of the branch due to the fluctuations of any arc.

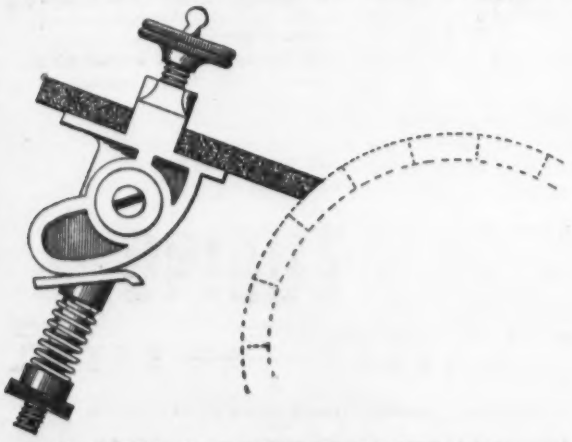
438,631. Telephone-Transmitter; Archibald J. McDonald of North Tiverton, R. I., Assignor to Henry E. Townsend, Trustee, of Boston, Mass. Application filed Dec. 12, 1889. In a telephone-transmitter, a diaphragm having its body made of hard carbon having its front face made of a suitable conducting material having a smooth surface.

438,632. Telephone; Archibald J. McDonald, of North Tiverton, R. I., Assignor to Henry E. Townsend, Trustee, of Boston, Mass. Application filed Dec. 12, 1889. This invention consists in the combination, with the diaphragm, of a lever pivoted at one end and having its shorter arm in contact with the back of the diaphragm, and its larger form a piece of carbon forming part of an electric circuit, a piece of carbon with which the carbon on the arm of the lever makes contact and also forming part of an electric circuit, and means for causing an adjustable pressure to one arm of the lever against the diaphragm, and of the other arm of the lever of the carbon carried thereby against the other carbon.

438,656. Electric Motor; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Jan. 15, 1885. The combination with the short circuiting magnetic bar and its coil, of a current-controller therefor and a governing magnet in a derived circuit around the armature.

438,657. Process of Electric Welding; Elihu Thomson, of Swampscott, Mass., Assignor to the Thomson-Houston Electric Welding Company, of Maine. Application filed June 14, 1890. The process of electrically welding three or more pieces together, by placing said pieces in abutment with one another in the desired relation, passing current through the joints until they assume the desired welding temperature, and then applying mechanical force to effect the welding.

438,658. Electric Welding of Pipes; Elihu Thomson, of Swampscott, Mass., Assignor to the Thomson-Houston Electric Welding Company, of Maine. Application filed June 26, 1890. The process of forming lap-welded joints between hollow metal pieces, as sections of pipe, consisting in heating the joint to the desired plasticity by passing an electric current through it, and



No. 438,668.—Brush Holder for Dynamos.

then effecting the weld by laterally-applied light impact or pressure repeated a number of times and properly graduated, not to contract or produce collapse in the work.

438,668. Brush Holder for Dynamo Electric Machines; Charles F. Winkler, of Troy, N. Y. Application filed July 26, 1890. The invention consists in the combination of a pivoted frame carrying the brush and provided with a heel or heels, each having two cam surfaces and a spring operated push device constructed to act upon the cam-faces to either maintain the brush in or out of contact with the commutator.

438,721. Thermal Cut-out; George Herbert Whittingham, of Baltimore, Md., Assignor to the Automatic Switch Company of same place. Application filed June 9, 1890. In a cut-out, the combination, with a movable head or support carrying a clamp, of means for automatically opening and closing said clamp, and a guide for a strip of wire supported in proximity to the clamp and in such relation to the devices for actuating the clamp that the strip of wire will be presented to and engaged by the clamp as the latter is brought near the guide.

438,723. Electric Blank Heating and Feeding Apparatus for Forging Machines; George D. Burton, of Boston, Mass. Application filed Aug. 22, 1890. In an electric blank heater, for heating blanks to be forged, the combination of a sliding carriage, oscillating electrodes supported thereon, a support for said carriage, means for reciprocating said carriage to shift said electrodes to release the blank.

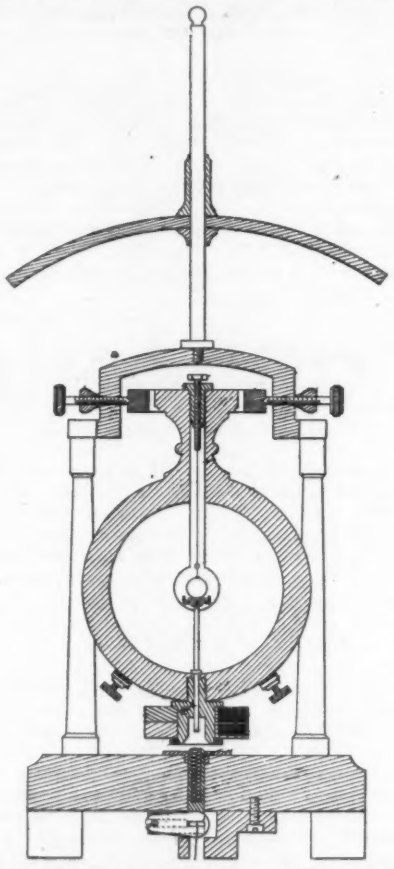
438,780. Electromagnet; Frederick M. Schmidt, of Brooklyn, N. Y. Application filed July 31, 1890. The combination, with a bipolar electromagnet, of an armature having a pivotal support in the line of the poles and tapering from its free toward its pivot end, and provided with a recess at or near end its free end, adapted in its movement toward the magnet to receive and surround one of the poles of the same.

438,784. Telephone; John Ch. H. Stut, of San Francisco, Cal., Assignor to the American Bell Telephone Company, of Boston, Mass. Application filed September 16, 1889. In a telephone, the hinged non-metallic swinging arm supporting the cap and carbon ball and maintaining contact by gravitation, in combination with an independent spring pressing upon the cap but insulated therefrom, said spring and arm producing a differential pressure.

438,788. Lightning Arrester; Anthony C. White, of Boston, Mass. Application filed July 19, 1890. The invention comprises a conducting earth plate mounted parallel and closely adjacent to a similar conducting plate connected electrically with the line, but separated therefrom by a thin di-electric partition interposed between the plates to maintain the requisite distance of separation, and slotted or perforated to facilitate disruptive discharge, one of the plates, preferably the upper one, having a plug of fusible conducting material fixed in a hole in its surface, which, fusing when an arc has been maintained from one plate to the other sufficiently long to heat them, runs down between the said plates and supplies a conducting medium there, which, rapidly cooling, solidifies and unites them electrically and conductively, furnishing a path for continuous and safe discharge.

438,814. Device for Automatically Insulating Broken Wire; Max Kerstein, of Boston, Mass., Assignor of one-half to Rudolph Furgang, of same place. Application filed July 14, 1890. A device for automatically insulating a broken wire in an electric circuit, comprising the following parts: a box or case of conductive material, a piston of conductive material, from which the electric wire extends, said piston being normally electrically intermediate with said wire and box, piston rod and spring, and suitably distributed insulated material, whereby when breakage of the wire occurs the piston is withdrawn by the spring into the box and the piston and wire insulated from the said box.

438,818. Telephone; James McDonough, of New York, N. Y. Application filed March 9, 1888. In a telephone system, the combination, with a local circuit in which circulates a current varied or modified to correspond to the elements or waves of the vocal or other sounds to be transmitted, of a main or line circuit, a condenser or series of condensers, and one or more circuit-shifters



No. 438,882.—Portable Reflecting Galvanometer.

for alternately connecting the condenser or the series of condensers successively to the two circuits.

438,827. Secondary Battery; Emile Nicolas Reynier, of Paris, France. Application filed Aug. 23, 1890. The invention consists in placing the ordinary electro-plates suitably isolated in a supple, not rigid, cell or receiver, and arranging on both sides of this cell or receiver parallel with the electrodes rigid clamping or compression plates, the said clamping plates tending to be constantly brought toward each other by elastic organs, such as springs.

438,828. Telephone; Wilton L. Richards, of Malden, Mass. Application filed Aug. 13, 1890. In a magneto-telephone, the inducing magnet, helix and diaphragm, in combination with a magnetic screen interposed between the body of the said magnet and the diaphragm.

438,837. Electric Drill; Gordon Buchanan, of Chicago, Ill. Application filed March 31, 1890. In an electric drill, the combination of two electro magnets, provided with hollow cores or spools, a movable armature placed between such magnets, a drill-stock attached to such armature and passing through the hollow cores or spools, and a circuit-closer adapted to be moved by the armature to close the circuit with each of said magnets in alternation.

438,847. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed March 16, 1888. Divided, and this application filed June 24, 1890. The combination of a railway track, a series of poles or posts arranged along said track, a supply conductor and a working conductor connected in parallel, and suspended upon the opposite sides or portions of said posts at an elevation above the track, and so that the surface of the working conductor adjacent to the track is unobstructed; a traveling car, an electric motor to propel said car, a collector moving with the car and making a traveling contact with the unobstructed part of the suspended working conductor, and a motor circuit on the car for supplying current from the collector to the motor.

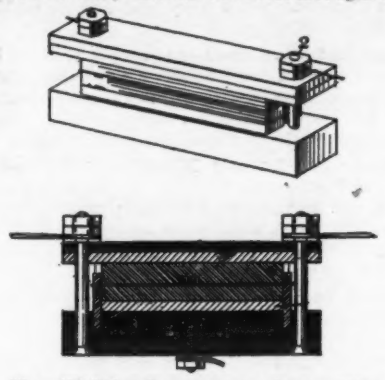
438,870. Magneto-Electric Transmitter; Archibald E. Todd, of Providence, R. I. Application filed July 23, 1890. The combination, with a track and series of iron plates forming a succession of sections of practically tubular cross section, of a tubular carriage surrounded by two or more magnets, each magnet provided with a wiper and connected with the track through the running-gear of the carriage, and a conductor connected with a dynamo and at successive intervals with contact-sections swept by the wipers, constructed to energize the magnets successively.

438,882. Portable Reflecting Galvanometer; Charles P. Frey, of East Greenbush, N. Y. Application filed December 26, 1889. In a deflecting galvanometer, the combination, with the frame carrying the magnet-coils and suspended mirror and magnet, and a main frame or support, of a universal joint connecting the two frames and by which the former is suspended to the latter.

438,891. Electrical Speculum; Samuel H. Linn, of Rochester, N. Y. Application filed March 26, 1889. In a speculum, the combination with a frame and speculum of the electric light attachment consisting of a cylinder, provided with a lamp and electrical connections and adapted to be fitted removably in a socket of the frame.

438,894. Trolley Switch for Electric Railways; Henry W. Marcy, of Utica, N. Y. Application filed July 17, 1890. This invention involves a trolley switch consisting of a plate gradually widened to make one end twice the width of the other, and which is provided with downwardly projecting flanges from end to end. A spring tongue is secured at the wide end of the plate, the free end of said tongue resting against one of the flanges, thus forming a double track at one end and a single track at the other.

438,897. Magnetic Separator for Paper-Pulp; Francis H. Richards, of Hartford, Conn. Application filed Aug. 29, 1890. In a magnetic-separator, the combination with the pulp-tank of the revolving magnet and the scraper bearing on said magnet, said tank having a magnet-case extending below the floor thereof and forming a passage-way concentric to the magnet and of substantially uniform thickness throughout the length



No. 438,788.—Lightning Arrester.

thereof, whereby the pulp is guided around the magnet contiguous thereto and whereby the pulp is intermixed between the stationary and revolving surfaces of said passage-ways.

438,934. Insulator; Fidel Miro, of Cienfuegos, Cuba. Application filed June 6, 1890. The invention consists in a casing formed of insulating material and made in halves, contact-pieces contained in the upper portion of the casing, and a pair of hooked arms pivoted in the centre of the casting, extending outwardly toward the ends, and provided upon their free extremities with hooks for receiving the ends of the sections of telegraph wire.

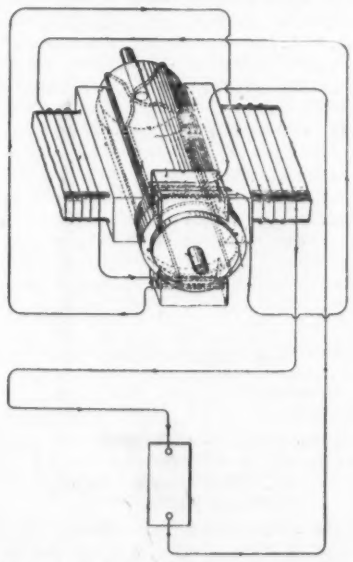
438,982. Telephone Exchange Apparatus; Franklin G. Beach, of Chicago, Ill., Assignor to the American Bell Telephone Company, of Boston, Mass. Application filed Feb. 5, 1889. The combination, with two telephone lines looped together in metallic circuit, of a galvanometer and battery in a bridge including resistance bridged across the strands of the cords by which the lines are connected at the central office, whereby said galvanometer is deflected while the circuit remains complete, the pointer of the galvanometer returning to zero when the subscribers hang up their telephones.

439,011. Arc Lamp; John Kent, of London, England. Application filed July 26, 1890. In an electrically-controlled arc lamp, the combination, with the upper and lower carbon-carriers and their operating-cords, of feed-wheels mounted on the same shaft and round which the cords extend in reverse directions, a wheel-gripping band, a spring-pan acting on one end of the gripping-band, and means operating on the opposite end of the band for turning the wheels to release one cord and wind the other to separate the carbons.

439,017. Apparatus for the Rhythmic Generation of Electric Currents; Charles Langdon-Davies, of London, England. Application filed Aug. 16, 1889. An instrument for generating rhythmic electric currents, consisting of a temporary magnet, a contact-stop, a single circuit-closer, and a vibrator co-operating with the circuit-closer whereby the periods of transmission and of cessation of impulses are equalized.

439,042. Electrical Transmission of Power; William Stanley, Jr., of Great Barrington, Mass., Assignor to the Westinghouse Electric and Manufacturing Company, of Pittsburgh, Pa. Application filed June 12, 1889. The method of transmitting power by alternating electric currents, which consists in establishing a field of force of alternating polarity embracing a rotatable armature by means of such currents, setting up in a conductor electrically connecting the armature coils two opposing electromotive forces by means of currents, alternating synchronously with the first-mentioned currents, and thereby causing currents inductively developed in those armature-coils which occupy positions of inductive effect in such field of force to transverse those armature coils which are not inductively affected when the armature is at rest.

439,047. Electric Lamp Socket with Regulating Attachment; William F. Wollin and Elmer H. Werline, of York, Pa. Application filed Jan. 28, 1890. In combination with an electric lamp and its socket, an exhausted receiver, a series of resistances arranged within said receiver, a series of wires running



No. 439,042.—Electrical Transmission of Power.

from said resistances to contact points, a governor making contact with any one of said points, as desired, electrical connections between said resistances, and a wire extending from the first resistance to the lamp and also to a contact point for said governor, the said resistance chamber being inclosed within the casing of the lamp socket.

439,069. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor, by mesne assignments, to the Thomson-Houston Electric Company, of Boston, Mass. Application filed July 14, 1885. Divided and this application filed March 12, 1889. In an electric railway having a main line and branch or siding formed with supporting-rails upon which the car runs and is guided, the main line conductors independent of the rails, in combination with the conductors of the branching track or siding, also independent of the rails, and electrical connections between the conductors of the main line or branching or siding track, by which current is supplied to the branch or siding conductors from the source of supply to the main line conductors.

439,070. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Electric Car Company of America, of same place. Application filed June 9, 1886. Divided and this application filed July 10, 1890. In an electric railway a working conductor from which a traveling motor receives electricity, made in sections, part of which sections supply electricity of one polarity and part electricity of the opposite polarity in combination with electric supply conductors and branch conductors connecting the supply conductors with sections of similar polarity,

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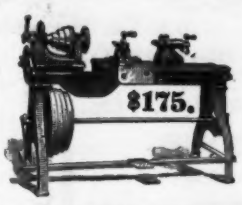

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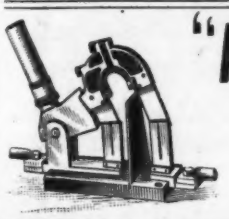

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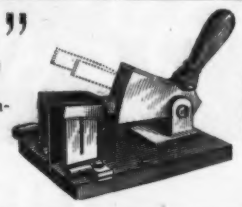

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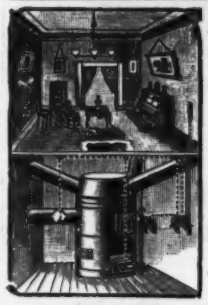

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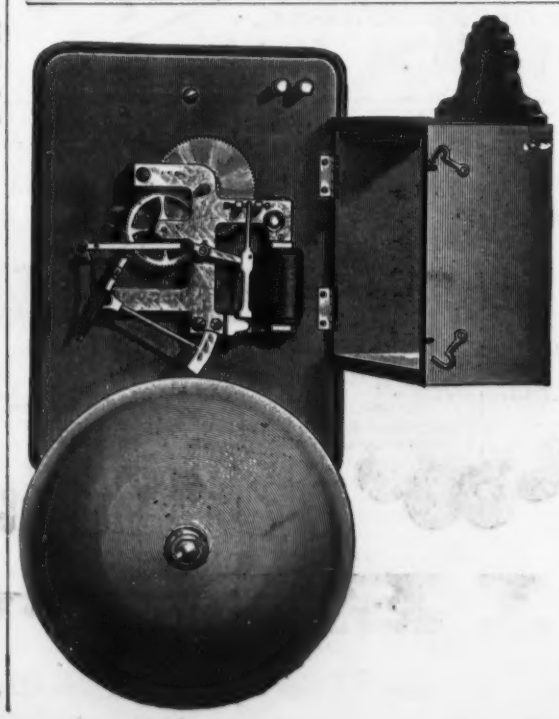

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